VOLUME XIII February, 1925 NUMBER 2

MAR 14 1925

[FOUNDED IN 1906 AS THE AMERICAN QUARTERLY OF ROENTGENOLOGY]

THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

OFFICIAL ORGAN
THE AMERICAN ROENTGEN RAY SOCIETY
THE AMERICAN RADIUM SOCIETY

Editor: ARTHUR C. CHRISTIE, M.D.

EDITORIAL BOARD

JAMES T. CASE, M.D. H. K. PANCOAST, M.D. WILLIAM DUANE, PH.D.

ADVISORY BOARD FOR PATHOLOGY

JAMES EWING, M.D. Cornell University
EUGENE L. OPIE, M.D. University of Pennsylvania
ALDRED S. WARTHIN, M.D. University of Michigan

PUBLISHED MONTHLY FOR THE AMERICAN ROENTGEN RAY SOCIETY
BY PAUL B. HOEBER, INC., 67-69 EAST 59TH STREET, NEW YORK CITY

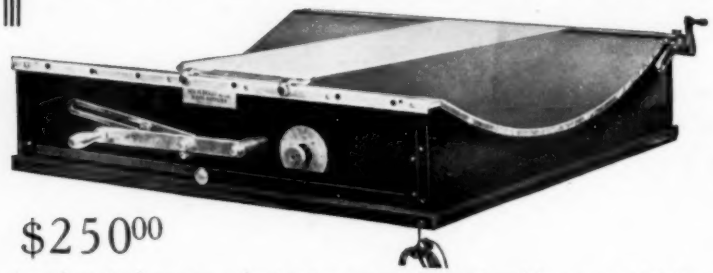
AMERICAN ROENTGEN RAY SOCIETY MEETINGS

Twenty-Sixth Annual Meeting
WASHINGTON, D. C.—SEPTEMBER, 22, 23, 24 AND 25, 1925

CENTRAL SECTION—*Seventh Annual Meeting*
CHICAGO, ILLINOIS

Entered as second-class matter, March 3, 1916, at the Post Office, New York, N. Y., under the Act of March 3, 1879.
YEARLY SUBSCRIPTION, $10.00 SINGLE NUMBERS, $1.50

BRADY'S POTTER-BUCKY DIAPHRAGM



$250.00

NEW FEATURES

A new and improved type of grid construction that secures even more brilliant results than our previous grid.

A neat compression band attachment for holding the patient still during exposure.

Patient brought nearer to plate.

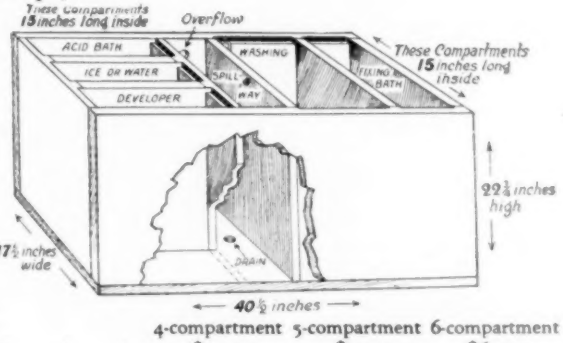
An electrical contact device for operating a signal lamp or which can be connected to most time switches for making the exposure automatically, from 1 to 90 seconds time at $5.00 extra charge.

Our speed control is accurate and reliable and timed in actual seconds. It does not require constant repairs. We claim it is the smallest, neatest and most effective Bucky on the market, 6:1 ratio grid cutting off practically 90% of secondary. Takes all makes of cassettes to 17 x 17 size, operates in horizontal or vertical position, and does Stereoscopic work in either direction.

All-metal construction electrically welded and practically indestructible. They do not get "out of date." Price $250.00 list with cash discount for quck payment.

DEVELOPING TANKS

Our stone tanks are considered the best designs and values on the market. Each has a space for ice or hot water for controlling the developing temperature. The 5 and 6 compartment styles also have a 4" air space to prevent temperature of wash water from affecting the temperature of developer. Lengths over all 24½"-34"-40¼" respectively. Illustration shows our regular 6 compartment style. Special styles to order. We have many sizes of enamel tanks also. Send for special circular.



	4-compartment	5-compartment	6-compartment
Prices shipped from Virginia	$45.00	$53.50	$60.00
Prices shipped from Chicago, Boston or Brooklyn	$50.00	$58.50	$65.00

DR. GRANGER'S SINUS MASK

For radiography of the sphenoid, etc., at 17° angle. We furnish these to fit all standard makes of cassettes. Specify outside size of your cassette when ordering. Made for 8 x 10 only. Price $8.50.

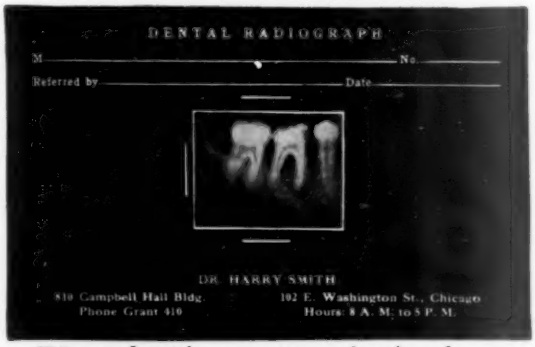
INTENSIFYING SCREENS

Get our net prices on screens either alone, or mounted in cassettes. It may save you some money. We are distributors on Buck X-Ograph cassettes, and carry the standard makes of screens.

BARIUM SULPHATE (Paragon)

We have furnished enormous quantities of this to the profession during the last 10 years. We are prepared to furnish this in prepared form with malted milk or dry milk incorporated at $30.00 per 100 lbs. packed in 25 lb. sealed tin cans. 5 lb. & 10 lb. sizes also available. Price of regular barium $24.00, fluffy style $26.00 per hundred.

DENTAL FILM MOUNTS



We can furnish many sizes and styles of mounts in cardboard or the all-celluloid types. Special designs if desired. Very liberal discounts are allowed on orders for 100 or more. Get our new price list #160—with discounts.

Special on gross lots of #1 size film $6.96.

ASK FOR OUR LATEST PRICE LIST AND DISCOUNTS

GEO. W. BRADY & CO., 761 S. WESTERN AVE., CHICAGO

THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

VOL. XIII FEBRUARY, 1925 No. 2

THE NOMENCLATURE USED BY THE REGISTRY OF BONE SARCOMA*

BY E. A. CODMAN, M.D.

Registrar of the Committee of American College of Surgeons on Bone Sarcoma†

BOSTON, MASSACHUSETTS

I wish to devote this paper to the classification of bone tumors, especially of bone sarcoma. One of the main objects of the Registry is to get a uniform classification which roentgenologists, clinicians and pathologists can use in order to have a mutual understanding of the clinical entities which are referred to. At the time the Registry was started, four years ago, there were many different terms in use and while each term was vaguely understood by all who were interested in bone tumors, yet there was a considerable amount of misunderstanding among individuals. When Bloodgood used the term periosteal sarcoma or Mallory used the term fibrosarcoma or Ewing used the term osteogenic sarcoma about an individual case, they might have meant the same entity, and they probably understood one another, but there is no doubt that other pathologists, clinicians and roentgenologists were confused and thought that these terms applied to three different entities. Our own committee of three, Dr. Ewing, Dr. Bloodgood and myself were accustomed to use different terms and although we understood one another pretty well, we had no hard and fast nomenclature. Two years ago a committee was appointed by the Clinical Pathological Association to formulate with us as definite a nomenclature as possible. This committee consisted of Dr. MacCarty of the Mayo Clinic, Dr. Sondern and Dr. St. George of New York, and Dr. Bell of Minneapolis. The following is the nomenclature which we adopted.

NOMENCLATURE SHEET

I have here set down my interpretations of what I believe the joint committees to mean by the terms agreed upon for common use by clinicians, roentgenologists and pathologists.

I cordially invite the individual members of the two committees, or any of our consulting pathologists, or any teacher or professor of pathology, roentgenology or surgery, to criticise the classification or my definitions of the terms.

If anyone believes that there are other clinical entities, he should register some cases and let me pass them about from laboratory to laboratory for the opinions of others interested, as Ewing has done in the case of his tumor. We should convince our colleagues before undertaking to teach the profession or our unfortunate students.

If anyone plans to use in his reports or to teach his students other forms of nomenclature, as being preferable to this, as a whole or in any detail of importance, we invite him to send us his improved nomenclature with explanations and illustrative cases, and we will enclose a copy in each of these boxes, as an alternative for this.

The Registry invites criticism in the spirit of cooperation.

E. A. CODMAN, M.D., Registrar.

*Read at the Twenty-fifth Annual Meeting, AMERICAN ROENTGEN RAY SOCIETY, Swampscott, Mass., Sept. 3–6, 1924.

† Dr. J. C. Bloodgood and Dr. James Ewing are the other members of the Committee.

NOMENCLATURE

1. *Metastatic Tumors.* Clinically the prognosis in these cases is universally unfavorable. Roentgenologically they are usually central. Histologically we believe they are usually true to the type of the original tumor to some degree and are seldom, if ever, purely undifferentiated tumors in bone.

2. *Periosteal Fibrosarcoma.* Clinically these are tumors which lie next to the bone, do not invade it although they may cause absorption by pressure on the adjacent surface of the bone. It is grossly impossible to determine whether they arose in the outer layers of the periosteum or in the adjacent fascia or tendinous insertions. They appear to be less likely to metastasize than the osteogenic sarcomas. Roentgenologically they may show changes in the contour of the adjacent bones, even pushing the bones to one side or bending them, but histologically they show no tendency to form osteoid tissue, cartilage and bone. It is this that separates them from our class of periosteal osteogenic sarcomas, which presumably arise from the osteoblastic layer of the periosteum. Periosteal fibrosarcomas are not distinguishable histologically from fibrosarcomas of the fascia.

3. *Osteogenic Tumors.* These are tumors which are believed to be derived from cells which are supposed to be the common ancestors of the cells which form bone, cartilage, the fibrous network of bone and the tissue formerly called myxomatous, which from the point of view of bone pathology is merely a phase of cartilage or fibrous tissue.

The benign forms are too well known to need special definitions.

The malignant forms are *osteogenic sarcoma*—true bone sarcoma. Clinically these growths have a bad prognosis and the proportion of the different component parts, fibrous, myxomatous, cartilaginous or bony, has probably very little influence in the prognosis, which apparently depends on the activity and quantity of the undifferentiated cellular portions of these tumors. We have therefore abandoned the attempt to separate clinical entities according to the preponderance of any element. All forms have much the same natural history.

Roentgenologically these tumors are far more frequently near the ends of the bone than in the shaft, although exceptions occur. They usually show a considerable amount of bone production, generally radiating outwards, but the more cellular types may simply destroy bone and therefore show erosion and invasion roentgenologically, without producing the characteristic radiating spicules.

Histologically these tumors usually show intercellular substance resembling fibrous tissue, bone, cartilage or osteoid as well as undifferentiated cellular tissue. Sometimes one or another of these elements predominates the picture, but usually all the elements may be found in some part of the tumor. Some are almost entirely composed of undifferentiated cells.

Certain *anatomic types* of these osteogenic sarcomas appear to be subordinate clinical entities. The commonest type is both *medullary and subperiosteal*, showing central bone destruction and subperiosteal bone proliferation. This type covers the great majority of cases. Occasionally one appears to develop chiefly in or under the periosteum, but the more our experience increases the more we find that it is a difference of proportion of medullary and periosteal involvement, rather than that these tumors are essentially either periosteal or medullary. We have agreed that it is necessary to carry a subdivision "*periosteal osteogenic* sarcoma" for the present. This merely means a sarcoma which histologically has osteogenic characteristics, but which is anatomically cortical or periosteal in situation. It is a very difficult matter to offer terms which will be satisfactory for the clinical entities which we call respectively "periosteal fibrosarcoma" and "periosteal osteogenic sarcoma," yet the Committee feel that clinically, roentgenologically and histologically they are different. It seems that periosteal fibrosarcoma has a better prognosis than periosteal osteogenic sarcoma. The terms are poor, for "periosteal" is used literally in the former and as noting derivation in the latter.

It is very unfortunate that the term "periosteal sarcoma" has been widely used in this country as synonymous with malignant bone sarcoma (osteogenic sarcoma). It is also unfortunate that the Committee feel obliged to retain the term "periosteal" and to apply it to two different entities still different from the much misused meaning. It is hoped that better terms will appear.

The amount of bone production in osteogenic sarcomas varies considerably. When it takes place through the great majority of the tumor we call it "*sclerosing*" (ossifying) and it may be that this type has a better prognosis than the less sclerosing forms. On the other hand, certain cases are so vascular, that they actually pulsate and grow with great rapidity, so that it seems that the group of "*telangiectatic*" sarcoma is clinically of much poorer prognosis.

It seems probable that the accidental difference of degree of freedom of communication in arterial and venous spaces in the tumor accounts for this difference. We do not believe that the cellular constituents are actually more malignant than in the other forms, but that the presence of blood spaces lined by tumor cells and in almost direct arteriovenous communication, allows the cells to be washed off directly into the circulation. The more sclerosed the tumor the less likely are the cell-lined spaces to be in direct communication with the blood stream. It may be that the better prognosis in periosteal fibrosarcoma can be explained by the infrequent occurrence of the cell-lined blood channels.

Roentgenologically these anatomic varieties are to a certain extent recognizable. Histologically they are much the same essentially, though the occurrence of much new bone or many blood spaces in a section would suggest that sclerosis or telangiectasis would characterize the rest of the specimen. The real distinction is the gross anatomy of the tumor. Telangiectatic spaces lined by tumor cells must be distinguished from atypical blood vessels, to avoid confusion with angio-sarcoma.

Undifferentiated Sarcomas are carried under the Osteogenic Sarcomas because such tumors arising in bone may be presumed to be of origin in cells destined to produce bone. That is, we believe that if these undifferentiated cells should produce any intercellular substance it would be fibro-, myxo-, chondro-, osteoid or osseous. The group of tumors which we call Ewing's Tumor perhaps should be placed in this class for some of our consulting pathologists, notably J. H. Wright, think they recognize a primitive osteoid substance in many of these cases. However, Ewing is inclined to believe them of endothelial origin and his opinion is gaining strength in the minds of others. Those who have studied the collection as a whole at least grant that this group is a clinical entity, probably of more favorable prognosis for radiation. At present we carry Ewing's Tumors under a separate heading between malignant angiomas and the myelomas, but it may be decided later that they belong with these undifferentiated tumors.

4. *Inflammatory conditions* are placed in the central portion of the list because on the one hand we have cases of excessively exuberant callus which approach malignant osteogenic sarcomas in their histology, and on the other hand there is also a borderline in such cases as osteitis fibrosa and bone cysts where the question of new-growth or inflammation is difficult to decide. Some pathologists, notably Mallory, even include under inflammation our next division, giant cell tumor. Roentgenologically inflammation may simulate new-growth so exactly that in many cases a diagnosis cannot be made. Histologically the same dilemma is present in a considerable number of cases and one has to wait for help from a knowledge of the outcome.

Under Inflammation is placed *osteitis fibrosa*. We recognize this as a useful term to include such forms of osteitis as Paget's disease, Von Recklinghausen's disease, and the various forms of single and diffuse cystic disease of bone which have not yet received a definite pathologic standing. Bone cysts belong under this heading, too, though they merge into the following.

5. *Benign Giant Cell Tumor.* A term used by Bloodgood to replace the old

term giant cell sarcoma is accepted by the Registry. The term is valuable for re-educational purposes. Many surgeons and pathologists were brought up to regard this type of tumor as more or less malignant. Up to the present date the Registry has found no instance of a clear case of one of these tumors causing a metastasis. Roentgenologically they are central tumors expanding the bone locally, giving a very different picture from the osteogenic sarcomas. Histologically this type is also distinct, although our consulting pathologists have not yet agreed on the probable histogenesis of the tumor. Any one studying the Registry cases will feel very sure of a well marked separation of these tumors as a clinical entity, and feel convinced that they are benign, whether or not he agrees with Mallory that they are essentially "inflammation and repair" phenomena.

6. Instances of benign *angioma* occur in bone as cavernous structures similar to cavernous angiomas in the soft parts. Roentgenologically they rarefy bone and expand it, in something the same way that giant cell tumors do, but having more and smaller loculi. We believe that malignant tumors of the blood vessels occur in bone, but we have as yet registered no case which is a typical *angio-sarcoma*. Many supposed angio-sarcomas are probably telangiectatic osteogenic sarcomas.

7. *Ewing's Tumor*. This tumor generally involves the shaft of the long bones producing a widening of the shaft, apparently by spreading apart the lamellae of the bone. It may involve the skull or the short bones. It is more apt to be multiple than true osteogenic sarcoma. Roentgenologically it shows a characteristic longitudinal striation and the tumor nearly always involves more than half of the shaft. It does not often produce the radiating spicules, but there may be onion-like layers of periosteal new-bone formation such as one sees in osteomyelitis. The roentgenological appearance is usually confused with osteomyelitis. It is an invasive, bone-destroying tumor rather than a bone-producing tumor, but it may set up a reactive formation of new-bone as in ordinary bacterial infection. Histologically, it is composed of undifferentiated round and polyhedral cells sometimes arranged in a perithelial manner about the capillaries, appearing in sections in sheets between the capillaries. Its histology is very characteristic. Its prognosis is bad, but these tumors yield at least temporarily to radiation, which the osteogenic sarcomas seldom do to any great extent.

8. *Myeloma*. These tumors are almost always multiple. They are central tumors and not bone producing. Roentgenologically they show no bone proliferation and are usually clearly defined, but may at times show invasion of the bone in a moth-eaten way resembling the characteristic picture of cancer. Histologically the cells resemble the myelocyte series. The histological diagnosis rests on these resemblances. There are said to be myelomas derived from the erythrocytes, but no such case has as yet been registered. For clinical and roentgenological purposes it is unnecessary to sub-divide the myelomas even histologically. The boundary lines are very difficult to draw, and for practical purposes the histologic varieties are the same clinical entity. They are invariably fatal, although local improvement with the *x*-ray may occur, and the disease be protracted for many years.

Borderlines. The nomenclature is arranged on the same principle as the Classification Sheet in each envelope, namely, that the entities which are likely to be confused should be next to one another. In classifying the Registrar is seldom in doubt between two different borderlines.

I will take up each heading and discuss the features which make each heading a clinical entity and try to illustrate what the roentgenological features of these entities are. Before proceeding with this, I want to call your attention to the introductory remarks, beginning "I have here set down" and ending "The Registry invites criticism in the spirit of cooperation."

In other words we have presented this classification and ask the teachers of surgery, roentgenology and pathology to use it or to differ publicly, saying they are going to teach their students some

other nomenclature which they think to be better. It seems absurd that the students in the various universities and the public in general should be taught several different nomenclatures. We want to put the burden of a better nomenclature on the teacher or ask him to teach ours. Ours is not wholly satisfactory and we would be glad to have a better one. We invite criticism. If anyone believes that we have left out any entity, let him register illustrative cases and we will include his entity in our work and leave it to future students or to the general opinion of the profession to decide whether his suggestions are superior to ours.

For practical clinical purposes there are only 8 or 10 clinical entities among bone tumors. Unquestionably each one of these entities may be subdivided according to its gross appearance, its roentgenological appearance, its microscopic appearance or even by its clinical behavior in individual cases. For instance, tumors of the same kind may look vastly different in gross appearance and still be osteogenic sarcomas. They may present under the microscope varying degrees of cartilage-like tissue or bone tissue or cellular growth, but still be the same malignant entity with the same clinical course as other tumors of vastly different histologic characteristics. To illustrate roentgenologically, osteogenic sarcoma may affect the bone wholly by absorption or may create new bone which presents in the roentgenogram the well-known radiating spicules.

It is clear therefore that neither microscopist nor roentgenologist nor the clinician can alone classify bone tumors. Classification must be done by a cooperative effort on the part of these groups, and it seems to me that we must look to the pathologist for the correlation of the different points of view presented by the examination of the tissue, the roentgenograms and the clinical life history of the case. I feel sure that the pathologists who have been associated with this effort, will agree that in the diagnosis of a bone tumor, the clinical history and roentgen findings should always support the microscope. When these data are collected about a case and any of the pathologists who have been studying these Registry cases review all the data, I believe that a definite diagnosis and prognosis can be given in over 90 per cent of the cases. We must admit, however, that even with all the facts before us there will be a small number of cases on which we have essential disagreement. In the cases hitherto collected essential disagreement seldom has occurred unless the data presented are incomplete. It is really shocking to find how seldom we are able to get the combination of a good history, a good roentgenogram and a good microscopic slide. Clear detail in the roentgenograms of bone tumors is of very great importance. Roentgenologists should not be satisfied with poor detail in these cases.

Let me now take up our classification. There are eight divisions or really ten, for the benign and malignant osteogenic tumors are different entities, and so are the benign and malignant angiomas.

1. Metastatic tumors of the bone.
2. Periosteal fibrosarcoma.
3. Osteogenic tumors, benign and malignant.
4. Inflammatory conditions.
5. Benign giant cell tumor.
6. Angioma (benign and malignant).
7. Ewing's tumor.
8. Myeloma.

These are the definite clinical entities which we hope to establish as the essential divisions of bone tumors. We want to be able to say that a patient who presents himself with a bone tumor must have one of these eight conditions. This implies that no others are known, which are not subdivisions of these eight classes. The question is much more important in which of these general classes a tumor belongs than it is in what particular subdivision of that class. In other words, the prognosis in each class is fairly definite. Metastatic tumors are, with very few exceptions, fatal. Periosteal fibrosarcoma is very unfavorable, but is probably slightly more favorable than osteogenic sarcoma. Osteogenic tumors if malignant are extremely unfavorable but if benign are decidedly favorable. We have to admit, however, that there are borderline forms in which we are not able to give a definite prognosis.

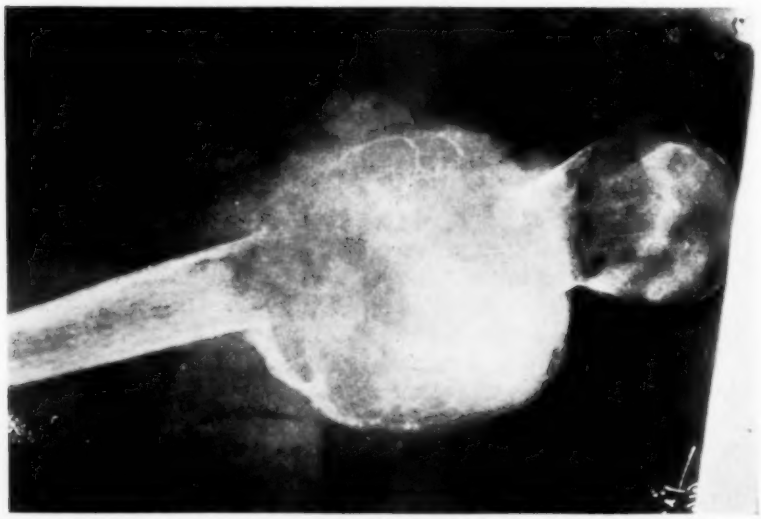


FIG. 1. From Registry #66, a case registered by Dr. L. F. Stewart of Clearfield, Pa. The histology was that of metastatic carcinoma in the opinion of Bloodgood, Ewing, Wright, Wolbach, Mallory and Phemister. The history pointed to origin in the thyroid. Death from metastases. This figure illustrates the method of growth of a malignant embolus of great vascularity and cellular activity. Globular local expansion of the bone resulted, in spite of an effort of the periosteum to lay down new bone. This is an extreme case but it is not uncommon for metastases to form similar areas of local central destruction and expansion of the cortex.

In some cases the presence of a carcinomatous metastasis is said to stimulate the bone to produce massive new bone, especially in the case of prostatic metastases. No such case has as yet been registered.

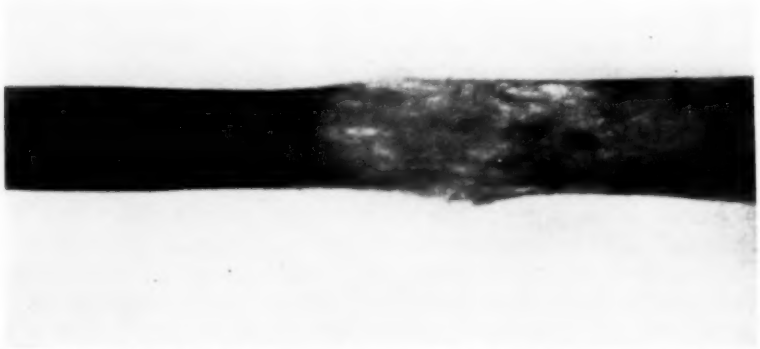


FIG. 2. This is from Registry #148, a case registered by Dr. P. P. Swett of Hartford, Conn. The histology was that of a metastatic carcinoma in the opinion of the pathologists. The history pointed to origin in the adrenal. This figure illustrates the invasive method of growth of a malignant embolus. Notice that the growth invades the cortex as well as the medulla. In this it resembles Ewing's tumor although the latter generally involves a much larger section of the shaft. This case also resembles a focus of osteitis fibrosa, and the presence of the pathologic fracture would be in keeping with this lesion.

Figures 1 and 2 together are very instructive from a roentgenologic viewpoint for they are certainly quite unlike and yet both represent carcinomatous metastases. In one the method of growth gives the appearance of giant cell tumor and in the other of Ewing's tumor. So in these instances the microscope is of more diagnostic weight than the roentgen ray. Yet we cannot say that thyroid metastases conform to one method and adrenal carcinoma to the other for we have instances where adrenal metastases caused the former type of localized expansion. However the roentgenologist might logically favor metastases rather than giant cell tumor for the latter is unknown in this situation. *Giant cell tumors always invade the condyles* except in young subjects before the epiphyses are united. Therefore expansive tumors of the shafts of bones are presumably metastases or myelomata. Cysts of the shaft not involving the condyles are seldom expansive and often have rounded lines of demarcation from the medulla.

Figures 1 and 2 illustrate the two chief ways in which metastases affect a bone according to whether the character of the tumor is expansive or invasive.

Inflammatory conditions are, as a rule, favorable. Benign giant cell tumor is favorable; so is angioma, although there may be perhaps, rarely, malignant angiosarcoma. Ewing's tumor probably has a more favorable prognosis from treatment by radiation than does any other form of malignant tumor of bone. In myeloma

Metastatic tumors certainly cannot be divided in this way. They are all unfavorable, with the possible exception of hypernephroma and thyroid metastases which are said sometimes to be solitary, and therefore may in exceptional cases be hopeful if the tumor, and also the primary focus can be removed.

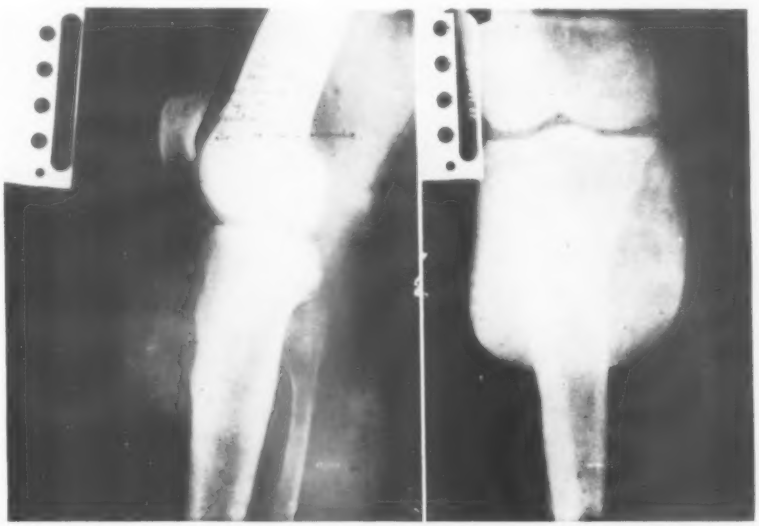


FIG. 3. Registry #189. A case published by Dr. Ashhurst. This patient recovered after a radical resection in 1915 and is still living, 1924. This is the most typical instance we have of a "periosteal fibrosarcoma." "The tumor when split open is firm and fibrous, white and glistening, attached to periosteum over head of tibia but not involving bone." Histologically it is a typical fibrosarcoma, without evidence of osteogenesis. The roentgenogram shows a slight indentation of the bone where it lies against the tumor, but no evidence of involvement.

Notice that our nomenclature includes in this class tumors which may or may not be bone tumors. Such a tumor as this might have arisen in the fascia, the tendon, the periosteum or the joint-capsule. Yet we may conceive of its arising in the fibrous portion of the cortical bone and growing outward. At any rate it represents a clinical entity sometimes curable by radical excision.

How does it differ from our subdivision periosteal osteogenic sarcoma? In three ways: (1) roentgenographically, only contour deformity is shown in the bone—no involvement; (2) microscopically, it is a fibrosarcoma indistinguishable from fascial sarcoma—no osteogenesis; (3) the gross specimen was attached to the periosteum. If it had been a periosteal osteogenic sarcoma it would have shown involvement of the cortex and the major portion of it would still be beneath the periosteum except where it had broken through it. It would have had the same dire prognosis as the typical osteogenic sarcoma which is practically always periosteal, cortical and medullary. The cross section would not show even a fine line of separation between bone and tumor. We have no clear case for illustration of a periosteal osteogenic sarcoma, but they probably do exist.

Oftentimes our data are not as complete as in case #189. If a case was registered in which it was clear that the bone was not involved and the slide showed a fibrosarcoma, the Registrar would place it in this class of periosteal fibrosarcoma. This name might be changed to extra periosteal or parosteal. We need a better name which will signify that the tumor may or may not be a true bone tumor but is adjacent to the bone.

which is usually malignant, the prognosis is slowly, but almost surely unfavorable.

Now let us consider the prognosis of the subdivisions of these general classifications to see whether we can divide these definite classes into more or less favorable types (Figs. 1 and 2).

By periosteal fibrosarcoma we mean a tumor adjacent to bone perhaps causing superficial erosion of the bone, but not starting in the bone. We have in the Registry but few tumors of this class although most of the pathologists who have been working on these subjects have seen

FIG. 4. Typical benign osteogenic tumor (not registered) pedunculated, and probably encapsulated on its external surface. The line of demarcation in the base is not definite, but if such tumors can be excised without breaking them and the base removed as deeply as possible in the shaft, they will almost surely be cured. Broken pieces scattered in the soft tissues may grow again locally; so may remnants left in the base. These tumors are usually bone at the base and become more and more cartilaginous at their summits. Not infrequently the areolar tissue which slips back and forth over the cartilaginous surfaces develops adventitious bursae. They have been called "exostosis bursata." It seems to the writer unwise to divide them into osteoma, chondroma and fibroma because they are almost invariably composed of all these elements in various proportions. They are frequently multiple, suggesting that the growth defect which produces them is of a general rather than a local character, but single tumors exactly resembling the multiple tumors do occur. There are several different terms applied to the multiple cases, but in the Registry nomenclature they are all "benign osteogenic tumors." They probably represent the growth of aberrant bits of epiphyseal cartilage.

within their experience tumors of a definitely fibrous type lying close to the bone, probably arising from the external layer of the periosteum or fascia. The impression is universal that these tumors are less unfavorable than those that clearly arise in the bone, that is, if they are locally thoroughly excised, there is a real chance of recovery. This impression is reinforced by a few cases which we have in the Registry. A very typical case has been reported by Dr. Ashhurst (Fig. 3). No

FIG. 5. This case, #222 in the Registry series, was sent us by Dr. A. J. Shadman of Forest Hills, Mass.

The patient was a man, aged twenty-one. The tumor had been present and steadily enlarging for 10 years. It was excised by Dr. Shadman in 1914 and the patient is reported well in 1924.

The case illustrates an extreme degree of benign osteogenic new growth. In a general way the more definite the pedicle, the sharper the peripheral outline, the less the trabecular changes at the base of the pedicle, the greater the mobility of the soft parts, the longer the history, the less the pain, the more likely is the tumor to be benign. Histologically, the more cellular the tissue and the more myxomatous the cartilage, the greater the suspicion of malignancy becomes.

But there are exceptions to all these points. There may be no pedicle and the tumor may even be endosteal, and therefore there is no peripheral outline. Also such a tumor may be benign for years and then show malignant changes and rapid growth. However, with full data a correct prognosis in most cases should be given by anyone who is familiar with the Registry series. To the writer, the benign osteogenic tumors represent aberrant growth toward adult type, while the osteogenic sarcomas represent aberrant repair. Undoubtedly trauma might combine the two and repair of a congenital benign tumor cause the advent of malignancy. Such a case as Dr. Shadman's must be near the borderline.

one has yet offered any subdivisions of periosteal fibrosarcoma. We must accumulate more cases before subdividing them.

The osteogenic tumors may be divided into two distinct classes, the benign and the malignant. Out of respect to the time-honored custom we have subdivided the benign osteogenic tumors into exostosis, osteoma, chondroma and fibroma. We considered the advisability of calling these all osteo-chondroma because they seldom present a pure structure and are nearly always mixtures of tissue resembling fibrous tissue, cartilage and bone. They are really one entity, rather than four. Essentially it makes no difference to the patient having one of these tumors whether it consists of fibrous tissue, cartilage or bone. If it does not contain cellular tissue and its structure is not too atypical, it is a benign tumor which if thoroughly excised, will not grow again nor cause metastases (Figs. 4 and 5).

Personally, I think it is better to speak of this group as benign osteogenic tumors than it is to try to differentiate these subordinate classes. These tumors are composed chiefly of bone and cartilage, but as any experienced roentgenologist or microscopist knows, the definite proportions of bone and cartilage appear to have little significance in any way. They are as a rule pedunculated and encapsulated.

The malignant osteogenic tumors are called osteogenic sarcomas. Just a word in regard to the term osteogenic. This term has been especially used by Ewing and if I understand its meaning correctly, it does not mean "bone forming" but "derived from bone" in the sense in which it is used as applied to bone tumors; nor does it mean strictly derived from bone, but derived from the tissues presumably intended to form bone. Suppose you were going to build a house and piled on the lot the raw material which you would have to use in making the house—the clay that you use to make the bricks, the sand which you use to make the glass, the lead which

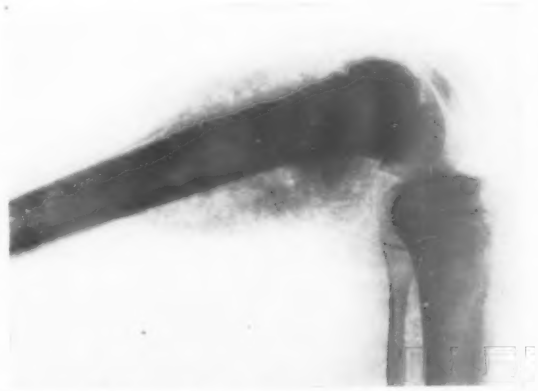


FIG. 6. Registry #513, reported by Dr. James G. Sherman, Woonsocket, R. I. In this case we have no tissue but the roentgen appearance is so typical that the diagnosis of osteogenic sarcoma may be made on it alone. It represents the typical method of invasion of the bone in this disease. One sees not only the tumor developing radiating spicules outside of the cortex but an area of loss of density within the bone itself. The old shaft is conspicuously present in the center of the tumor which surrounds it like a callus. This case is a typical instance of what the radiologists have called periosteal sarcoma. There is no reason to suppose that the tumor originated in the periosteum or in the center of the bone for almost all of these osteogenic sarcomas involve both periosteum and medulla. It is therefore unessential to describe them as central or periosteal.

It is the hope of the Registrar that the term osteogenic sarcoma will be used for such cases as this because periosteal is clearly a misnomer. Its only meaning is that the tumor is *more* periosteal than central, and this has no clinical significance.

FIG. 7. Another type of osteogenic sarcoma in which the osteolytic factor is more pronounced than the osteogenic. The general shape and confirmation of the tumor is similar to Figure 6. The remains of the old shaft are present, but no definite new bone production is visible; furthermore the microscope fails to show any evidence of bone or cartilage production in the section submitted, the histological picture being that of a fibrosarcoma. It is very doubtful whether this osteolytic form of osteogenic sarcoma is of any different nature clinically from the more typical case shown in Figure 6 where osteolysis and osteogenesis are both present.

Phemister believes that the Registry should classify these separately. We shall be glad to do so if the follow-up of these cases shows that there is any difference in their clinical course.

you use to make the paint and so on to the other parts which will compose the complete house. Now if someone came along and made some sort of a grotesque structure which might vaguely resemble a house but which consisted of all sorts of bizarre variations of sand and bricks, clay and windows and angles and corners, this would be a house-ogenic tumor. The house would be composed of the materials intended to make a house but laid down without a normal plan. Osteogenic sarcomas bear the same relation to a

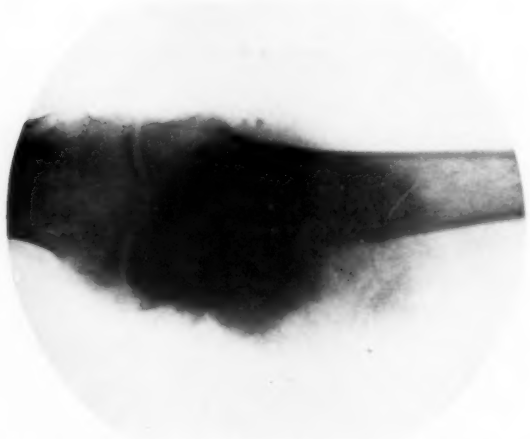


FIG. 8. Registry #—, a case submitted by Dr. Bloodgood.

This is the type which we call sclerosing. It shows the same general contour and presence of the old shaft, but instead of osteolysis, there is abundant osteogenesis. The sections also show marked increase of new tumor bone. This case merely illustrates the extreme grade in the opposite direction from Figure 7, which shows practically all osteolysis and no osteogenesis. In other words the three tumors show the same disease, but different phases or types. Possibly these types have different clinical histories especially this sclerosing form which has always been thought since the days of Virchow to be more slowly progressive than the more cellular type. As yet the statistics of the Registry do not reinforce this belief, but it is not time to report on this matter, for at present these sclerosing forms apparently show little if any, better prognosis than the osteolytic forms; in fact, the osteolytic forms may have a better prognosis from treatment by radiation than the sclerosing forms, though perhaps the danger of metastases from the sclerosing form may be less.

normal bone, they are composed of the basic material intended to make bone or repair bone but they are laid down in irregular and fantastic fashion with absurd proportions of the components (Figs. 6, 7, 8 and 9).

In callus or normal bone repair, for instance, there is a process of osteolysis followed by a process of osteogenesis. This normal process of repair must have some solvent action to round off the old ragged bone edges and this solvent action must be followed by an osteogenic action which welds the ends together. Therefore, in osteogenic sarcoma which I believe is an abnormal process of repair or callus, we see varying degrees of osteolysis and osteogenesis. In some cases the tumor cells seem to have a corrosive power. The bone in contact with them dissolves and disappears. In other parts of the tumor irregular osteogenesis may take place and a far greater amount of bone be deposited than is needed. This is important to remember in roentgenological interpretation, because from your point of view an osteolytic tumor gives a very different picture from one which is producing bone, yet osteogenic sarcoma is the cause of both processes and the prognosis is just as bad in one case as in the other. Osteogenic sarcomas, therefore, may be wholly osteolytic or almost entirely osteoblastic, for I am told by Professor Thompson of the University of Texas, that osteoblastic is the correct word when you mean that a tumor is actually producing bone. An osteogenic tumor is only potentially osteoblastic. However, it is very exceptional for an osteogenic sarcoma to be wholly osteolytic. Both processes go on side by side.

I have been over all the roentgenograms of the registered cases in which there is no doubt of the diagnosis of osteogenic sarcoma. I have found that very few cases show only osteolysis, and only one shows no osteolysis and this is probably due to a technically poor roentgenogram. Nearly all show both osteolysis and osteogenesis. After collecting more cases we may be able to determine whether the prognosis is worse in proportion to the degree of osteolysis; but at present, so far as we can see, there is no material difference. Probably osteolytic forms are more favorable for radiation. We are at present discussing, at the suggestion of Dr. Phemister, whether these osteolytic tumors should not be considered a separate entity. The writer

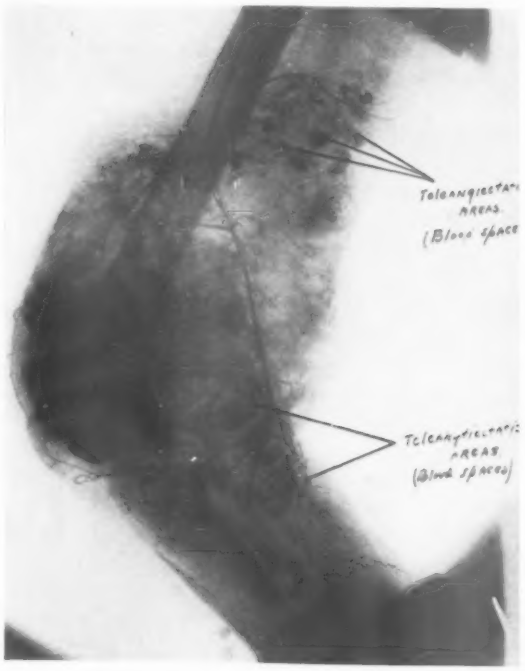


FIG. 9a.

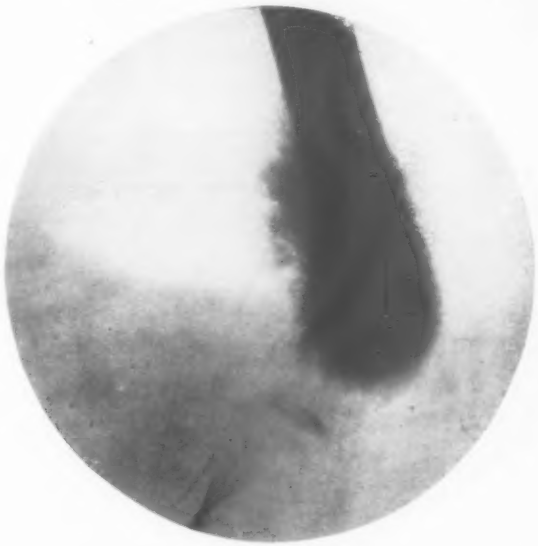


FIG. 9c.

FIG. 9b.

FIGS. 9a, 9b, and 9c. From an advanced case of telangiectatic osteogenic sarcoma in the same region, #334 registered by Dr. Adair of New York. The arterial injection makes the dilated blood spaces conspicuous. It differs from the others merely from the fact that the arteriovenous communication is more direct and hence the arterial pulsation dilates the spaces in the tumor through which the blood flows, as explained in the text. These blood channels are often lined by tumor cells hence the possibility of metastases is heightened and the growth more rapid and sinister. This tumor also belongs to the sclerosing type as shown by the roentgen ray before the arterial injection. The gross photograph shows that it is also of the medullary and subperiosteal type. Other such instances where one tumor belongs to three types might be cited to show that the subdivisions of osteogenic sarcoma are merely minor and perhaps unnecessary clinical classes.

There are, however, certain roentgenologic characteristics of osteogenic sarcoma as opposed to giant cell tumor. In nearly all osteogenic sarcomas one sees the old shaft within the tumor in its former position, on the contrary giant cell tumor expands the shaft. The method of growth is quite different, for osteogenic sarcoma, whether central or periosteal in origin, burrows diffusely through the cortex and grows inside and outside the old bone, often laying down new tumor bone both inside and outside the shaft. That laid down outside the shaft is usually in ridges or spicules radiating away from the center. The advance of giant cell tumor, on the contrary, is expansile, pulsating, aneurysmal, absorptive in its character. These tumors are bloody but contain no blood vessels. The red cells are in a mesh of round or spindle cells which I believe to be endothelium and others believe are fibroblasts. Probably this is a distinction without a difference but at any rate the red cells are circulating freely in this pulsating bloody sponge.

The effect on the bone is pressure absorption from within outward until the periosteum is reached. At this point the soft tissues give with each pulsation and the subperiosteal osteoblasts keep up a line of defence by attempting to produce new bone. I believe the shell of giant cell tumors is new bone—not the old expanded shaft (cf. Fig. 14).

Figures 6, 7, 8 and 9 all represent cases of osteogenic sarcoma of the lower end of the femur. Contrast their variation from an intense bone production to none at all. Histologically they are quite unlike. Yet those who have studied the Registry series believe all to be the same deadly clinical entity—osteogenic sarcoma. The roentgenological and histologic differences are great but their natural history is the same.

holds that they are extreme instances but have no difference in prognosis. Histologically they are fibrosarcomas.

FIG. 10.

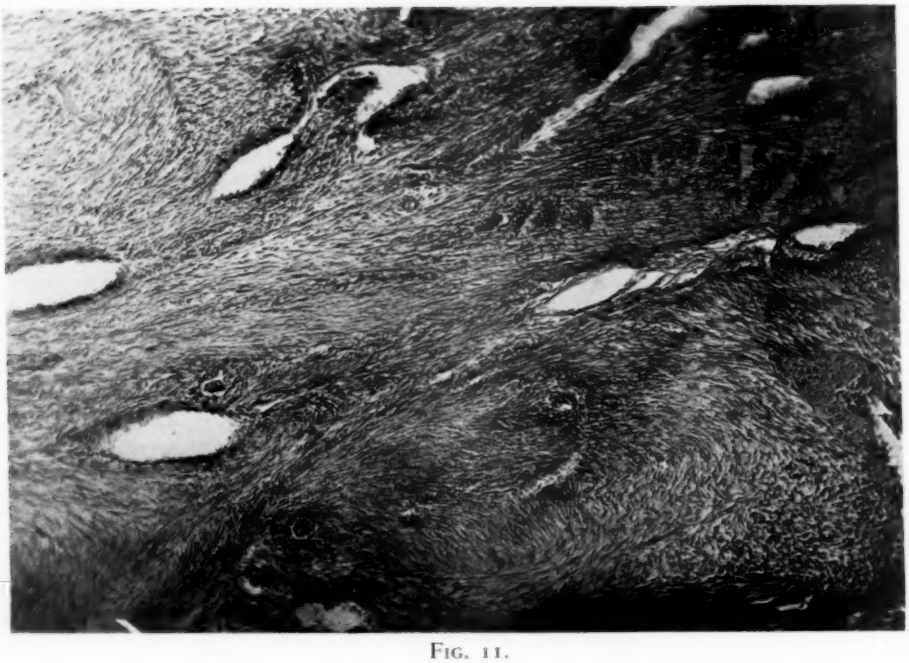


FIG. 11.

There are many different ways of subdividing osteogenic sarcoma. In the past both the pathologists and surgeons who have written on this subject have used sub-classifications according to cell terms or tissue terms. There was supposed to be some prognostic difference between spindle cell sarcoma, round cell sarcoma, etc. Even mixed cell sarcoma was a term

in common use. I cannot myself tell you what mixed cell sarcoma means nor have I been able to find any pathologist who is willing to define mixed cell sarcoma. It is a vague term merely meaning that the slide shows a variety of cells. The ordinary giant cell tumor, for instance, is a mixed giant and spindle cell tumor and used to be called sarcoma.

Attempts were also made to base prognosis on the tissues which the sarcoma mimicked. Such terms as fibro, cellulo, osteoid, chondro, myxo and osteo sarcoma were used and collections subdivided accordingly.

Anyone who has studied the Registry cases will agree that these terms are not sufficiently definite so that in an individual case a number of different pathologists can agree to use the same term. Here is one of our cases for instance which all now agree is an osteogenic sarcoma, but which in the early days of the Registry was classified by the different pathologists under these different headings.

J. C. Bloodgood—Periosteal myxo-sarcoma
J. Ewing—Myxo-chondro-sarcoma
F. B. Mallory—Osteogenic-fibro-myxo-sarcoma
J. H. Wright—Osteo-chondro-sarcoma
C. Y. White—Mixed cell sarcoma
H. Fox—Myxo-sarcoma
W. C. MacCarty—Fibro-chondro-osteo-pseudotextoma
A. C. Broders—Osteo-fibro-myxo-sarcoma

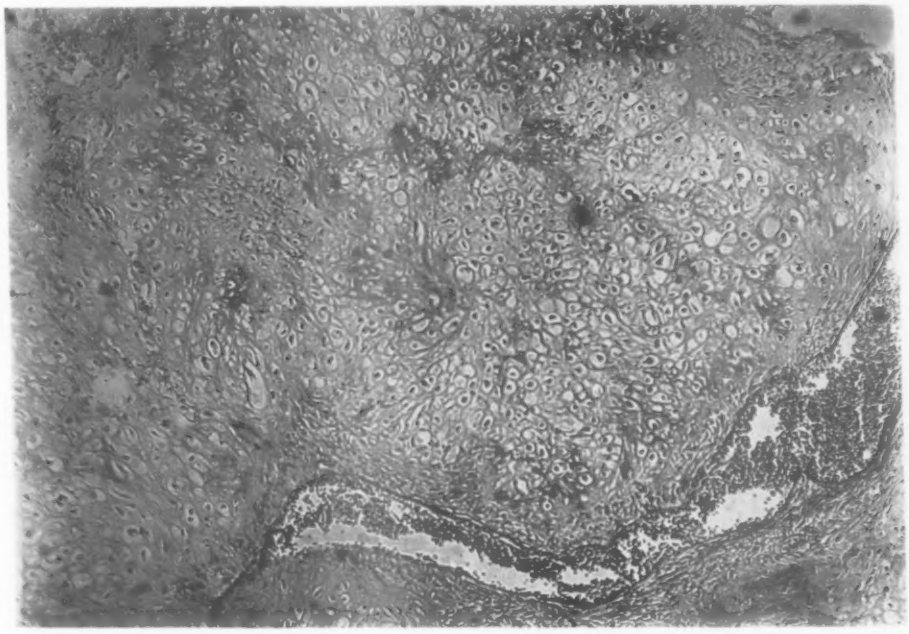


FIG. 12.

FIGS. 10, 11 and 12. These microphotographs are all from the same case #335, registered by Phemister. They illustrate the absurdity of trying to separate osteo and chondro and fibrosarcoma of bone. This tumor had separate nodules which were chiefly osteosarcoma, chondrosarcoma and fibrosarcoma respectively. Moreover the metastases in the case showed a like variation. One could find no better proof that it is folly to subdivide osteogenic sarcomas entirely by tissue resemblances in a single section.

The Registry furnishes many instances in which by selecting different fields the tumor could be called by any one of these names. Moreover there are intermediate grades of tissue in which the intercellular substance lies between fibro and myxo, between myxo and chondro or between chondro and osteo, etc. Other parts of the same tumors may show merely cellular tissue with no intercellular substance and in which the cells are evidently osteolytic in character. One is forced to the conclusion that the product of the cells of the same tumor may be osteolytic or fibroblastic, chondroblastic and osteoblastic. Furthermore in naming the individual tumors the pathologists so often disagree on whether the terms fibrosarcoma, chondrosarcoma, myxosarcoma and osteosarcoma should be used, that it is hopeless to obtain authoritative unanimity. They do however unite on the term osteogenic for the whole class.

When our collection accumulates so that we have at least 100 of each type we may attempt again to see whether the prognosis varies according to the preponderance of each of the fibro, myxo, chondro, osteo elements.

Another slide from another part of the tumor might have changed the opinion of any one of them. Their variation in terminology was simply a minor descriptive difference in characterizing the particular section which was seen. There was no prognostic nor therapeutic, indication which was of consequence, whichever one of these terms was correct (Figs. 10, 11 and 12).

I am inclined to think that the subclassification of osteogenic sarcoma which we ourselves use at present, is of very little more value, yet I hope that when our collection has reached greater numbers we shall be able to divide osteogenic sarcoma into still further clinical entities.

We have attempted to subdivide osteogenic sarcoma into four anatomic types. I am not sure that these types are worth separation. The first is the medullary and subperiosteal. The more our experience has grown, the more universal this type seems. Practically every osteogenic sarcoma of which we have a good roentgenogram or a good opportunity to examine the gross specimen, shows both medullary and subperiosteal invasion. This type therefore is more of a descriptive term for all osteogenic sarcomas than a subdivision.

If you could examine our collection of roentgenograms of many instances of each of these classes of tumors, you would be struck by the general resemblance of the members of each class to each other as opposed to those of the other classes. For instance, practically all of the osteogenic sarcomas do not invade the condyles while practically all of the giant cell tumors do. In practically all the osteogenic sarcomas one sees both osteolysis and osteogenesis, *and the remains of the old shaft in the tumor*. On the other hand, all the giant cell tumors are osteolytic, central and the old cortex is *expanded and is outside the tumor*. The collection reminds me of influenza cases in the army; an individual case was hard to diagnose but when one saw a whole ward full, the characteristics of the whole group were evident.

The second subdivision is "periosteal." There are probably a few osteogenic sarcomas that involve the periosteum and cortex without invading the medulla. I am inclined to think that this is an unnecessary subdivision because it has no clinical significance and merely indicates cases in which the medullary or central invasion is not very obvious. It is a very fine distinction to say periosteal osteogenic sarcoma as opposed to periosteal fibrosarcoma. This is particularly true because Bloodgood has for years used the term periosteal sarcoma in the same sense that we use the term osteogenic sarcoma. I think that periosteal sarcoma is almost universally used by roentgenologists. They thus designate the true malignant type of bone tumor which we call osteogenic. I find that it is fundamentally incorrect because these tumors are, as stated above, almost always both periosteal and central. I believe Bloodgood himself is willing to admit this fact and when he uses the term periosteal sarcoma it is more from habit than from mental conviction of its appropriateness.

The third anatomic type is sclerosing. This term has been commonly used by pathologists since the days of Virchow, as synonymous with ossifying. It means that the tumor has produced dense bone. This type is easy to recognize roentgenologically, microscopically and pathologically. It is held to be slower growing clinically than the cellular forms. These tumors probably are of slightly better prognosis but not enough cases have accumulated to furnish any statistical proof of this fact.

The fourth anatomic form is telangiectatic. This merely means that the tumor is more or less riddled with dilated bloodvessels or blood spaces. When, in a bone sarcoma the arteriovenous anastomosis within the bone due to breaking down of bony septa, has reached a point where the arterial pulsation is pretty direct into the blood channels of the tumor the pressure expands these channels. These channels are frequently lined by tumor cells or at best by a single layer of endothelium. The rush of blood through such a tumor may be so great that the whole tumor expands with each pulsation. Formerly such cases were called bone aneurysms. We now know that this condition occurs quite frequently although the degree is not great enough to make the whole tumor pulsate. We

believe that this anatomic type justifies a separate subdivision because of its unusually bad prognosis. It presents the most favorable condition for metastasis, because the blood stream can tear off cells from the sides of the blood channels and wash them into the pulmonary circulation. In the roentgenogram this telangiectatic condition may be suspected where there is irregular loss of bone substance in the interior of the bone. After amputation it may be beautifully shown by opaque arterial injection, as demonstrated by Dr. Frank Adair.

Sharply contrasted with telangiectatic osteogenic sarcoma are the giant cell tumors which also have a very direct arteriovenous connection but in which the cells are not malignant. Yet in the old days these too were called "bone aneurysms." Histologically their structure is quite different for in giant cell tumors the circulation is in the capillary mesh of the tumor.

You will notice another subdivision of osteogenic sarcoma entitled undifferentiated sarcoma. Tumors of this class are always necessarily osteolytic. In the roentgenogram they simply show loss of bone substance, no bone proliferation. Microscopically they are composed of round cells which show no tendency to form any known structure or tissue. That is, these tumors are round cell sarcomas occurring in bone and from their *position* are classed as bone sarcomas, not because they are known to be derived from bone or bone elements. Some of us think that this class should include Ewing's tumor which will be described later. At any rate, it is a class of tumors which we might as well admit are of unknown derivation; it being merely an assumption that they are bone tumors. My personal opinion is that they represent the normal process which precedes callus formation and smooths off the old ends. Under the microscope one sees these little round cells working through all the tiny spaces and canals and the bone melting away before them, just as in normal bone we see marrow spaces forming.

I cannot leave the discussion of osteogenic tumors without mentioning the term myxoma which has been used so much by my colleague Dr. Bloodgood, and others, and which perhaps deserves a position as a clinical entity. I think it was the consensus of opinion of the two committees who formed this classification that myxoma in bone is to be considered as atypical fibroma or chondroma. We find myxomatous tissue in many tumors, benign and malignant. Sometimes it is the preponderating tissue in tumors, but more commonly it is seen as a phase in a tumor which in other regions shows various degrees of atypical appearance of fibroma or chondroma. It also appears frequently in malignant osteogenic sarcoma. On the other hand, there are typical areas of myxoma in osteitis fibrosa and in bening giant cell tumor. We doubt the advisability of considering it a real tissue. There is no case in the Registry of a pure myxoma or myxosarcoma. Even Bloodgood has not registered his published cases.

The fourth clinical entity in our classification is "inflammatory conditions." It is needless to say this is capable of many subdivisions. For the purpose of the Registry it is unnecessary to go into great detail in this, but unavoidably we receive instances of inflammatory conditions which are especially apt to be mistaken for bone tumors and I sometimes think that we have less trouble in differentiating the various forms of malignant bone tumors from one another than we do in differentiating inflammatory conditions from bone tumors.

An inflammatory condition commonly mistaken for bone tumor is myositis ossificans. This has been and probably will be again in individual cases difficult to differentiate from osteogenic sarcoma. The well-known criterion for roentgen differentiation is that the new-formed bone lies as a whole parallel to the shaft instead of perpendicular to it as in osteogenic sarcoma. The mistake of confusing these two will seldom be made if good roentgenograms are obtained (Fig. 13).

Under osteoperiostitis is included the great majority of bone tumors due to inflammation and commonly spoken of as osteomyelitis. We have subdivided this division into three: traumatic, syphilitic, and infectious. Traumatic conditions such

as hemorrhage in the bone with its resulting repair and also cartilage and bone production in callus, may at times simulate bone tumor. It is hardly in the scope of this paper to discuss this heading in detail. I am rather glad to dodge it, because it seems to me one of the hardest problems the roentgenologist meets is to differentiate between callus complicated by osteomyelitis and osteogenic sarcoma. The other two subdivisions of osteoperiostitis are syphilitic and infectious, the latter including tuberculosis and various reactions to pyogenic infection. Ewing's tumor especially is hard to distinguish from osteomyelitis by the roentgen ray. In the case which illustrates this article it resembles Brodie's abscess.

The final subdivision under inflammatory conditions is osteitis fibrosa. This

FIG. 13. This is probably a case of myostitis ossificans although some pathologists have considered it a peculiar sarcoma. The case is Registry #263 and was reported by Dr. J. R. Paul of Philadelphia, Pa.

Resection of the fibula November 17, 1919. Amputation was done on Feb. 25, 1923, and the patient was reported as living October 20, 1924.

The roentgenogram shows the spicules of new bone laid down more or less parallel with the shaft instead of radiating perpendicularly from it as in osteogenic sarcoma.

This instance of myositis ossificans is more confusing than usual, for frequently the roentgenogram shows a distinct line of separation between the bone and tumor, the mass lying in the muscle. Sometimes, however, it seems almost to surround the shaft of the bone. As in this case the mass or masses not infrequently resemble the muscle bellies.

term is used in its broadest sense. It includes the various cystic or fibrous conditions in the bones of patients with Paget's disease, osteomalacia and the associated diseases characterized by multiple cysts. It also covers the simple bone cyst and the diffuse endosteal fibrous tumors called by Bloodgood solid osteitis fibrosa. In some of these cases the pathologic distinction between inflammation and new growth is hard to draw. Unavoidably the cases of the most typical form of osteitis fibrosa usually found in young people and consisting of fibrocystic degen-

FIG. 14. An extreme instance of osteitis fibrosa resembling histologically a low grade of osteogenic sarcoma of fibro chondro type, #220 in the Registry series and reported by Dr. J. W. Sever of Boston, Mass. Under observation ten years and still living with deformed femur, and lesions in other bones.

When there is an endosteal tumor which involves a large portion of a shaft of a bone particularly if there is bending or bowing of the bone, osteitis fibrosa should be suspected. Oftentimes there is a definite line of demarcation at the ends of the growth giving a convex outline like that of giant cell tumor, but occasionally the margin of the healthy bone is not clear cut and may even have an irregular appearance of an invasive character similar to that seen in some cases of metastases and in most cases of Ewing's tumor.

Solitary bone cysts are included under osteitis fibrosa although it is fairly certain that some of them are giant cell tumors in which the arterial connection is cut off and the tumors have undergone cystic degener ation.

erate changes in the shaft of the long bones are occasionally mistaken for sarcoma (Figs. 14 and 14*a*). I would like to stress the point that central tumors of the bone which are not metastases or multiple myeloma are seldom malignant.

The fifth division in our classification is benign giant cell tumor. The evidence of the Registry stands behind Bloodgood in the attitude which he has taken in considering this tumor benign. Over 100 cases have been registered; in very few has there been any real question of metastases, so few that errors in primary diagnosis are probably responsible. This tumor

FIG. 14a. A solitary cyst with pathologic picture. Registry #73 sent by J. C. Hubbard of Boston.

may proceed from one bone to another wherever two bones are connected by broad ligaments, the tumor advancing between the lamellae of the ligaments in those portions of the body where the bones are intimately connected, as in the tarsal bones, the vertebrae and the upper and lower ends of the tibia and fibula. It is not uncommon to have this occur. My own view is that giant cell tumors are endothelial sponges in the mesh of which blood corpuscles freely circulate. It is the pulsation of the whole sponge which dilates the bone causing the common roentgen-ray appearance of inflation. If a broad ligament happens to be attached to the cortex of the bone, the two halves of the ligament will be separated and the tumor will gradually intrude between them and on into the other bone (Figs. 15 and 16).

As yet we have no subdivisions in benign giant cell tumor. Histologically they are very similar although occasionally they are complicated by the presence of cystic

FIG. 15. A benign giant cell tumor, Registry #34, reported by Dr. Frederick Kammerer of New York.

Notice the clear cut limitations of the tumor, the apparent expansion of the bone and the fact that the tumor has descended far into the condyle. If a large group of roentgenograms of bone tumors were separated into two divisions, (*a*) those which invade the condyle, and (*b*) those which do not, practically all those which invade the condyle would be giant cell tumors and practically all those that do not invade the condyle would be osteogenic sarcomas. This is especially true in the femur and is also true in most of the other bones although exceptions occur, particularly in the tibia. This figure shows that the tumor is confined nearly entirely to one condyle of the bone. This is not uncommon in cases of giant cell tumor of the femur and they may also occur in a similar way involving one condyle of the tibia. Roentgenologists in making a differential diagnosis between a giant cell tumor and osteogenic sarcoma would not go far astray if they base their decision entirely on the two factors of whether or not the old shaft showed in the tumor or was expanded by the tumor and whether or not the tumor descended into the condyle practically to the cartilage.

Metastases and myeloma and bone cysts are the only conditions likely to be confused with giant cell tumor. Metastases are prone to affect the shaft in the neighborhood of the nutrient artery while giant cell tumors are always close to the joint and never in the shaft. Myeloma is usually multiple, while giant cell tumor rarely is. Bone cysts, I believe could be separated from giant cell tumors by measurement; that is, the transverse diameter of a giant cell tumor compared to its long diameter is greater than the difference of the same dimensions in a bone cyst.

FIG. 16a. Shows a giant cell tumor of the tibia which has invaded the fibula as shown by the roentgen ray.

FIG. 16b. Shows the same tumor after amputation in gross section.

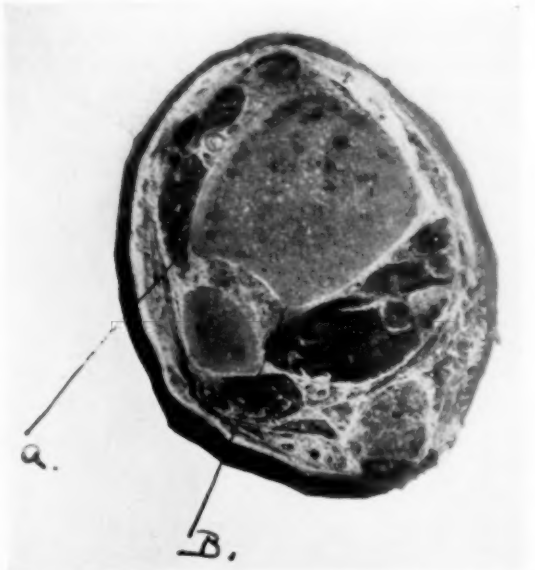


FIG. 16c. Shows a frozen section of a normal ankle-joint at this point. The broad tibio-fibular attachment lies between A and B.

The facts shown in these three figures may be interpreted in two different ways, one appealing to those who regard giant cell tumor as a benign mass of granulation tissue, the other appealing to those who regard it as a neoplasm.

My own view is the former. I believe that as the circumference of the tibia enlarges from the intraosseous pressure the points A and B on the tibia would become wider and wider apart, thus making a point of least resistance for the intrusion of the tumor into the spongy bone of the end of the fibula. In the spine where there are many broad ligaments giant cell tumors may pass from one vertebra to another, in the same manner.

Professor Wolbach who has been studying many of the Registry cases with me, feels that the interpretation of the facts presented by these three figures favor the view that giant cell tumor is a true neoplasm and advances as an autonomous new-growth from its inherent growth propensities, rather than from the mechanical character of a pulsating sponge in direct communication with the blood stream, creating intraosseous pressure.

The photograph of the gross section also shows two other points characteristic of giant cell tumor: (1) the tumor has extended down to the joint cartilage; (2) it has extruded as a fungous mass through the old operative incision. While these fungous masses occur in other kinds of tumors they are particularly characteristic of this type. Histologically, these masses are especially confusing as they grow very rapidly and hence show more mitoses and a greater pleomorphism than the tissue which one finds at the first operation, while the tumor is still under pressure within the bone. One should always discount histologic malignancy, in such extruding masses. It may be that this extrusion is nature's method of healing.

FIGS. 16a, 16b and 16c. Case #212 registered by Dr. David Cheever of Peter Bent Brigham Hospital.
Three figures to illustrate the method of invasion of giant cell tumors from one bone to another in those portions of the body where bones are bound together by broad ligaments.

degeneration, fibrosis, chondrification, or ossification. The work of Ewing and Herendeen[1] following that of Pfahler and other pioneers in attempting to heal giant cell tumors by the use of roentgen rays has been a wonderful inspiration, and I should be much interested to know why these progressive pulsating tumors can be made to fibrose and ossify under radiation, but it is a fact that this often occurs.

FIG. 17. Registry #249, reported by Dr. A. P. C. Ashhurst of Philadelphia, Pa.

A man aged thirty-five, with a tumor of the tarsal scaphoid. A cyst-like cavity containing currant jelly-like material curetted September 16, 1922. Was reported well in the summer of 1924.

The histology was that of benign angioma, similar to that seen in tumors of the soft parts. Roentgenologically it is indistinguishable from a giant cell tumor or cyst except that the loculi are smaller. In 2 other cases of benign angioma, one of the skull, Reg. #230, and one of the ilium, Reg. #153, the loculi are even smaller than in this case. Three cases are too few to base a general rule upon, but tumors of bone presenting the appearance of giant cell tumors with very small loculi should suggest the possibility of this condition.

The sixth division is angioma. We have 3 registered cases of bone tumors which roentgenologically resemble giant cell tumors, being central and expansive, but which in section show the structure of benign cavernous angioma (Fig. 17). The

FIG. 18. Registry #173, reported by Dr. James Ewing of New York. An instance of the type we call "Ewing's tumor," believed by Dr. Ewing to be endothelial in character but in the opinion of the writer belonging to the group of osteogenic sarcomas of undifferentiated type. The roentgenological characteristics do not differ greatly from those of osteomyelitis. There is central invasion of a diffuse character involving the cortex as well as the medulla. There is also bone proliferation which Ewing believes not to be due to the tumor itself but a protective effort of the periosteum to restore the bone. Notice that the upper and lower outlines are not clear cut as in cyst or giant cell tumor. Many cases of this condition show a more definite longitudinal striation than does this case. The bone is often widened apparently by the infiltration of the lamellae by the tumor itself, thus spreading and widening the bone. It is the belief of the writer that Ewing's tumors are osteogenic sarcomas but that the histology and general method of growth is modified because of their origin in the shaft rather than near the ends of the bone. As a whole, Ewing's tumors are osteolytic in character, seldom showing as much increase in the bone as is present in this figure. After radiation rapid osteogenesis takes place. The writer believes this is because radiation changes the function of the cells from osteolysis to osteogenesis. At any rate it is a fact that this osteogenesis occurs and it is one of our interesting problems to determine whether this new bone is normal or produced by tumor cells.

[1] Herendeen, R. E. The roentgen ray in the treatment of giant cell tumors. AM. J. ROENTGENOL. [etc.,] 1924, xii, 117–125.

roentgenologic appearances are very similar to those of giant cell tumor but the loculi are smaller. One of these tumors, a very large one of the ilium, was treated successfully with roentgen radiation. The other 2 were excised successfully. On the basis of these 3 cases, and a few others mentioned in the literature, we have made this heading of angioma of bone. It will take many more cases to establish it as an entity worth considering in diagnosis.

FIG. 19. Registry #242. An instance of myeloma registered by Dr. John Homans of the Peter Bent Brigham Clinic of Boston.

This occurred in a woman aged fifty-nine. Shoulder-joint amputation was done since at that time there were no other tumors present in the other bones. Six months later other tumors appeared and the patient died.

Under the heading of angioma you will notice the sub-heading of benign and malignant. Benign I have just considered. The malignant forms of angioma in bone are evidently rare. We have left this subdivision more as a compliment to those who have used the term angiosarcoma than because we need it to include any group of our tumors. I have invited my colleagues and many other pathologists, privately and publicly, to register a case of angiosarcoma; no one as yet has done it. The fact is that this term was used in the past for the vascular or telangiectatic forms of osteogenic sarcoma. I mention it largely because I hope no roentgenologist will use it.

The seventh division is Ewing's tumor (Fig. 18). At about the time the Registry was started in the fall of 1920, Ewing had begun to notice a group of tumors with pretty definite characteristics in that they nearly always involved the shaft, invaded the whole bone, cortex and all, did not produce bone, and consisted of small round cells with no tendency to formation of intercellular substance. Also they happily had the characteristic of rapid regression under radiation. These tumors probably correspond to those Gross classified as periosteal and central round cell sarcoma. Ewing is inclined to consider them endothelioma. Most of the pathologists who have been taking part in the work of the Registry have greatly enjoyed the opportunity of studying the instances of Ewing's tumor and curiously enough, as our collection has accumulated, we have found many tumors belonging to this type. As a matter of classification we carry this tumor under Ewing's name, rather against his will and more or less to his mortification, because he not infrequently disowns a tumor which the Registrar tries to place under his name. At any rate, all those interested in the Registry now think they recognize Ewing's tumor, although most of them probably think it more properly belongs in our classification under the heading of undifferentiated sarcoma in the osteogenic group than under endothelioma. However, we continue to carry it in our classification because after all the fundamental unit in our classification is "clinical entity" and this tumor is certainly a clinical entity.

I not infrequently guess the diagnosis either from the slide, the roentgen appearance or the history. If you see in the roentgenogram a tumor of the shaft in which the bone has a striated appearance as if the disease was invading the marrow spaces

and separating the lamellae, thus swelling and widening the whole shaft and cortex, the likelihood is that you will find in the slide a round cell tumor with no intercellular substance, and you may feel tolerably sure that roentgen radiation will cause the disappearance of the tumor, at least temporarily. I am sorry to say you may confidently expect before many years metastases in the lungs and often also in the skull and other bones. This tumor has not as yet been subdivided nor does it seem likely that it will be, although possibly the whole class may be thrown back under the classification of undifferentiated osteogenic sarcoma.

The eighth and final heading is myeloma (Fig. 19). No instance of a solitary myeloma has been registered. Myelomas consist of round cells resembling myelocytes. There is no bone production, for myelocytes have no intercellular substance and therefore would not be expected to cause osteogenesis. Like some giant cell tumors they may occasionally cause a considerable reactive bone proliferation from the periosteum so that thickening of the bone at the periphery of the tumor may result. For the purposes of the Registry or for common use among clinicians, roentgenologists and pathologists, it is unnecessary to subdivide myeloma. A question may be raised whether myeloma is not really a form of osteogenic sarcoma. We need many more cases to give us a right to any convictions at all on the finer points in myeloma.

LIST OF DESCRIPTIVE ADJECTIVES AND PREFIXES used in the Literature for Bone Tumors. These terms should not be used as clinical entities, but to describe characteristics of tumors. When correctly used they are not objectionable, but they are often used incorrectly and lead to confusion, leaving the impression that a large number of different clinical entities exists.

CELL RESEMBLANCES

Round { small
Spindle { large
Oat cell
Giant cell { foreign body
true tumor
Mixed cell

TISSUE RESEMBLANCES

Fibro-
Myxo-
Chondro-
Osteo-
Osteoid
Osteogenic
Osteogenetic
Osteoblastic
Ossifying
Xantho-
Sclerosing
Cellular

RESEMBLANCES TO VASCULAR RELATIONS

Endothelio-
Haem-
Lymph-
Angio-
Cavernous
Capillary
Telangiectatic
Perithelial

ANATOMIC RELATIONS

Multiple
Diffuse
Periosteal
Extraperiosteal
Parosteal
Subperiosteal
Central
Invasive
Solid
Dural
Alveolar
Medullary
Myeloid
Myelo-

SUBDIVIDING MYELOMA

Lymphocytic
Myelocytic
Erythroblastic
Plasma cell

You will notice in the left hand column on the face of a Registry envelope this list of adjectives which have been and may be applied to bone tumors. The use of these adjectives is to be discouraged unless great restraint is used. They are nothing more than descriptive terms. They are not the nouns or entities. It is possible to reduce them to an absurd prolixity. I could take from our collection almost any individual case and correctly apply a half dozen of these adjectives to it. I think we could show many cases, for instance, of mixed round and spindle cell giant cell tumors. We certainly could furnish many cases of mixed round and spindle cell fibro-chondro-sclerosing, central and periosteal osteoblastic sarcomas, and we might further qualify some of these also by other adjectives. I mention these absurd compounds merely to show you to what depths of confusion you may reduce the very simple subject of bone tumors. In reality

the bone tumor diagnosis comes down to six entities, if you omit metastatic tumors, inflammatory conditions and angioma.

For all intents and purposes the person who presents himself with a bone tumor which is not inflammatory or metastatic, may be told that he has one of five tumors—periosteal fibrosarcoma, prognosis fair with complete excision; benign osteogenic tumor, prognosis excellent with radical excision; osteogenic sarcoma, prognosis bad no matter what its treatment although a few recoveries following amputation are on record; benign giant cell tumor, prognosis good under almost any treatment except bad surgery; Ewing's tumor, prognosis good for immediate reduction under roentgen radiation, but eventually bad; myeloma certainly and slowly bad but probably retarded by radiation. All these types have, I believe, their definite roentgen criteria and all these types have pretty definite microscopic and clinical characteristics. Furthermore, these roentgenological, pathological and clinical criteria will not be materially changed by qualifying these terms with any of the adjectives in the left hand column. Cases of osteogenic sarcoma die pretty quickly whether they are fibro, chondro, osteo, round or spindle cell and Ewing's tumor is no worse for being called multiple, diffuse, central, alveolar, perithelial or invasive. All these adjective terms are like the colors of our neckties which make very little difference to anyone except to ourselves but are sometimes useful to describe a man if you do not know who he is.

THE DIFFERENTIAL DIAGNOSIS OF CERTAIN CHRONIC LUNG LESIONS

A Roentgenological Study

BY FRANK S. BISSELL, M.D.

MINNEAPOLIS, MINNESOTA

ANATOMICAL considerations which are of the greatest moment in this roentgenological study are as follows:

1. The anatomical unit of the lung is the lobule. In man, this consists of a group of ductuli alveolares, their connecting air spaces with their blood vessels, lymphatics and nerves, marked out by connective tissue septa.

2. The bronchial artery (the nutrient artery of the lung) is distributed to the walls of the bronchi, the connective and lymphoid tissue of the lung and also supplies the lymph glands of the hilum. It also extends to the pleura, and there furnishes a special blood supply to the lymphatics.

3. The pulmonary artery follows in all its subdivisions, the subdivisions of the bronchial tree. At its terminus it comes to occupy a central position within the lobule, dividing into as many branches as there are atria connected with the ductulus alveolaris belonging to that particular lobule. Each atrial artery divides into branches which pass to the sacculi alveolares, in the walls of which they break up into the capillary network of the lung.

4. The lymphatics follow closely the distribution of the blood vessels. Beyond the ductuli alveolares no lymphatics are found; in other words, no lymphatics are present in the walls of the air spaces.

The main trunks following the pulmonary artery are connected by numerous loops and there is thus formed a network with a long mesh.

Lymphatics, leaving the bronchial network, pass to two small veins, which arise from the ductuli alveolares. These lymphatics join the network about one of the venous trunks in the periphery of the lobule. The lymphatics about the pulmonary veins also communicate with the pleural lymphatics. While throughout the lung the lymphatics are as a rule destitute

of valves, a valve is present at the junction of the deep lymphatics with the pleural lymphatics. *This valve opens toward the pleura.* In the pleura there is a very rich network of lymphatics which contains numerous valves.

The distribution of lymphoid tissue within the lung and the relation which it bears to the air passages, blood vessels, lymphatics and pleura should interest the roentgenologist, for these masses frequently serve as centers to which disease processes may be conveyed through the lymph stream. Along the larger divisions, true lymph nodes have been described in the angles formed by the dividing bronchi. In the normal ductuli alveolares, Miller has found masses of lymphoid tissue situated between the muscular coat and the accompanying branch of the pulmonary artery. Again, at those important landmarks where the bronchi divide, and at the distal end of the ductuli alveolares, there are small masses of lymphoid tissue bearing a direct relation to the lymphatics which arise at these points. Also, at the various angles formed by the junction of smaller veins and lymphatics with their trunks.

Certain Important Pathological Considerations:

1. Aerogenic infection, with lodgment in the finer bronchi, is the most generally accepted method of invasion in adult tuberculosis.

2. Mixed or secondary infection is known to modify greatly the course of tuberculosis.

3. Tuberculosis offers many bizarre manifestations and varied forms and types but, at least from roentgenologic observations, all of these are essentially alike in the incipient stage of the disease.

4. As elsewhere in the body so in lung infections the factors of virulence on the part of the infecting agents, and of resistance on the part of the invaded tissues and of the attacked individual, determine the pathological lesion.

5. Suppurative lung infections fall into one of three groups: (1) bronchiectasis; (2) bronchiectatic abscess; (3) suppurative pneumonitis.

6. I have not been able to find reports of pathological studies of non-suppurative, non-tuberculous lung infections, except the pneumonias. Reports of microscopic pathology in suppurative infections are however of much interest in consideration of roentgen observations in the non-suppurative types. Thus Aschner says, "Cross sections of bronchial branches show round cell and leucocytic infiltration, the sub-epithelial layer being converted into a vascular granulation tissue. The peribronchial connective tissue is similarly infiltrated. The amount of destruction of the elastic lamina depends upon the degree of infiltration of the wall.

Roentgenological differential diagnosis is necessarily based upon the recognition of these and other pathological and anatomical facts. Since in chronic pulmonary disease, the problem is usually that of differentiating tuberculous from a non-tuberculous infection, it is necessary to bear in mind certain characteristics of the tuberculous lesion which tend to distinguish it from those of other infections:

(1) The earlier lesions in adults occur in the area of Chauvet, between the first and third dorsal spines, alongside the vertebral column. This manifests itself in the stereoscopic roentgenogram by an area of infiltration which seems to follow and surround the vertebral bronchial trunk. This area of infiltration, however, seems to persist long after healing or arrest has occurred, and for this reason is not a wholly reliable diagnostic sign.

(2) A second situation for early lesions of tuberculosis, one nearly as frequent and far more characteristic is anteriorly, in the second and third interspaces near the periphery of the lung. These lesions are doubtless produced by the aspiration of tuberculous material which lodges in the very fine terminal bronchus, the proliferative and inflammatory process around it being confined at first to the primary lobule. The roentgenological manifestation is a very limited area of fine infiltration, with a variable degree of diffuse cloudiness. It is sometimes possible to distinguish the cone shaped conformation of the lung lobule itself.

(3) "Tuberculosis frequently manifests a chronic, almost healed lesion in one lung and an acutely active lesion in the other."

This accounts for the apparent differences between the findings of the roentgenologist and clinician, each finding his most marked signs of disease in a different lung.

(4) Tuberculous pleurisy, either with or without effusion, is practically always associated with an already existing tuberculosis of the lung, frequently at the opposite apex. Hence, one is usually justified in ruling out tuberculosis when the stereoscopic roentgenogram shows no evidence of pulmonary tuberculosis.

(5) Fibrosis and calcification are manifestations of tuberculosis which indicate a pronounced tendency to heal, but do not in themselves justify a roentgen diagnosis of healed tuberculosis. Caseation can frequently be recognized roentgenologically and is always a sign of active tuberculosis.

(6) The early apical lesions may become relatively latent, while the disease progresses in the middle and lower lobes, but a basal tuberculosis, without some earlier involvement in the apex of one or both lungs, is too rare to be of practical significance. If one does not accept this hypothesis, he must at least admit that a differential diagnosis of tuberculosis of the lower lobe cannot often be made roentgenologically. This is true because the basal reactions to other infections and inhalation products are very extensive, widespread and common, and they either mask or closely simulate those of tuberculosis.

(7) "The common condition in the ordinary incipient cases, is a thickened pleura with definite fibrosis of greater or less extent underneath it, in the lung tissue proper, and at the lower border of this fibrosis, areas of caseation varying in size from a millet seed to a marble, and immediately below, scattered tubercles, either isolated or in the form of grape like clusters." In different cases, these scattered tubercles contain more caseation or more fibrosis, depending on their activity or their tendency to heal. Caseation frequently manifests itself in the roentgenogram by a cloudy area, which gradually shades into the normal lung surrounding the lesion.

We still have to consider tuberculous bronchopneumonia and cavity formation. The exudative reaction to the tubercle extends into the alveoli, forming a definite patch of bronchopneumonia. The pneumonic exudate may occupy but a few alveoli, or it may involve one or more entire lobes. From a roentgenologic viewpoint, these patches do not differ markedly from those commonly observed in streptococcus infections of the lungs. It is their distribution, and especially the presence of other changes previously described which makes the differentiation possible. As this pneumonic process develops one of two things may occur: (1) alveolar walls undergo necrosis and we have caseous pneumonia, when we have much more dense shadows than those of the usual bronchopneumonia of either tuberculosis or streptococcicosis; (2) or proliferation of the connective tissue occurs, with organization of the fibrinous exudate, resulting in what is commonly called "fibroid tuberculosis." When this occurs, we usually observe characteristic deformities of lung, pleura, and mediastinum with retraction of the trachea.

When conglomerate tubercle formation reaches a certain size, softening results from its caseous avascular condition. It is usually possible to make a roentgenologic differentiation between a cavity and simple abscess, by searching other parts of the lung fields and finding the more characteristic evidence of tuberculosis.

Reparative fibrous tissue proliferation accompanying cavitation may be readily recognized and evaluated in the roentgenogram, and this is an important part of the roentgen report since it has so much bearing upon the prognosis.

Since 1914 the writer has called attention, in various papers, to a large group of cases showing in their roentgenograms evidences of pulmonary infiltration and bronchopneumonia-like changes, which did not seem to admit of any recognized pathological classification. From a clinical standpoint, these cases were always suspected of tuberculosis but were never typical, and there was always a notable absence of marked constitutional symptoms. Unless complicated by bronchiectasis there was little expectoration, but there was sometimes a long history of cough, and occasionally hemoptysis. Fever was not uncommon, but it lacked the characteristic curve of

tuberculosis. In searching for an explanation of these phenomena, the tonsils and sinuses were investigated in a series of cases, and streptococcic foci demonstrated with surprising frequency. It was also found, that when sputum was obtainable the streptococcus was usually the predominating organism. Based upon these observations, and largely as a matter of convenience in reporting the condition we began employing, in the roentgen department of the University Hospital, the term "chronic pulmonary streptococcicosis." My observations of chest roentgenograms during the years which have succeeded that time, have convinced me that both the term and the condition which it attempts to describe, are entirely rational. Especially striking were the acute streptococcic bronchopneumonias observed in such numbers in some of the military hospitals in the epidemics of 1918 and 1919. It was my privilege to study a number of these roentgenograms through the courtesy of Dr. John Hunter Selby at the Walter Reed Hospital, and the similarity of the changes noted to those which I had previously described as chronic streptococcus infections, was very marked. In the acute cases, the process was always unilateral at first, and if it became bilateral, the disease was usually fatal. In the chronic condition, the process is almost invariably unilateral, and usually confined to one of the lower lobes. In the epidemic there was no evidence that the disease was especially prone to develop in men carrying foci of streptococcic infection, but there was much to indicate that the epidemics had their origin from streptococcus carriers. In the chronic condition, it is probable that the infection always has its origin in some focus in the upper respiratory tract.

The roentgenological differentiation between tuberculosis and other chronic lung infections is not always a simple matter. There are, however, certain rather well-defined characteristics of a tuberculous infection which, if kept constantly in mind, will serve to guide one away from error in a very large percentage of cases. Foremost among these is the marked tendency to early involvement of the lung parenchyma without typical pneumonic manifestations. As a result of this tendency we find evidence of infiltration of lung areas well beyond the reaches of the finer bronchi. Since the process is often restricted, for the time, to one or more primary lobules, we find such areas taking on a pyramidal shape, with the base of the pyramid toward the periphery. This infiltrating process occurs, as a rule, in the upper lung fields, and this fact is a fortunate one for the roentgen diagnostician, since this part of the lung is notably free from the effects of other infections, and of dust and other foreign body inhalations. In those comparatively rare types of basal or peribronchial tuberculosis, the differentiation is more difficult, and at times perhaps impossible. In so-called peribronchial tuberculosis, the fine tubercle-like shadows are often separated by a narrow but appreciable zone of normal lung, from the linear bronchial shadows, whereas in other infections, the process seems to spread directly from the bronchi themselves into the surrounding lung. This, however, is probably not a dependable differential point. The writer believes that it is, on the whole, safer to depend upon clinical evidence for the differentiation of basal lesions, but roentgenologic observations may point the way to the correct diagnosis.

SUMMARY

Accurate roentgenologic diagnosis of lung lesions must be based upon anatomical and pathological knowledge. Abnormal densities are the expression of pathological change.

Both the distribution and character of tuberculous densities are significant and quite characteristic.

Chronic lung infections due to other organisms have not received much attention from pathologists because they do not directly cause death and are usually unrecognized by clinicians. They are however of frequent occurrence and may be observed roentgenologically.

A STUDY OF THE INFLUENCE OF HIGH VOLTAGE ROENTGEN IRRADIATION ON SALIVARY SECRETION IN DOGS AND ITS EFFECT ON THE SENSIBILITY OF THE BUCCAL MUCOSA*

BY JAMES T. CASE, M.D., AND W. N. BOLDYREFF, M.D.

From the Radiological Department and the Pavlov Laboratory of the Battle Creek Sanitarium

BATTLE CREEK, MICHIGAN

A. THE INFLUENCE OF HIGH VOLTAGE IRRADIATION ON SALIVARY SECRETION IN DOGS

IN accordance with the general effect of irradiation on glandular tissue, it would naturally be expected that the salivary glands would be affected unfavorably and in a depressant manner by highly filtered radium and roentgen rays. Every roentgen therapist knows the dismay experienced immediately after treatment by certain patients suffering from malignant lesions about the neck and face when the physician has neglected to warn them of the impending dryness of the mouth and throat. In some cases this dryness has persisted for a considerable period of time. In patients with salivation, e.g., some cases of Parkinson's disease, great difficulty is experienced in controlling the excessive salivary secretion by radiation, and repeated doses must be given at intervals of four to six weeks. There is with this treatment a slight temporary increase in secretory activity, coinciding with a clinically observed temporary increase in the size of the irradiated glands, occurring within a few hours of the application.

These clinical observations have given rise to certain questions: How long does this mouth and throat dryness persist after radiation? What is the qualitative and the quantitative effect on the salivary secretions? Do these effects disappear in time? What is the value of radiation in the treatment of intractable salivation?

Clinically, in a general way, the answer to these questions is known. Even after very intense irradiation of the throat and mouth regions (as for carcinoma of the tongue, lips, thyroid, etc.), although the patient experiences real suffering as the result of his salivary drouth, including disturbances of taste variously described by different individuals, in time the subjective taste and secretory disorders disappear and conditions return to normal.

In our experimental work on dogs, Pavlov's method was employed; first, because by this method it is possible to determine quantitatively the normal work of the gland, and to study this work after roentgen treatment repeatedly on the same dog; and second, because in Pavlov's method the work of the gland can be investigated by means of natural irritants (stimulants), introduced into the mouth (e.g., by means of feeding the dog with equal quantities of a certain definite food under definite conditions).

For such experiments dogs with permanent salivary fistulae are used. In order to prepare such a salivary fistula the orifice of the duct of the salivary gland chosen is led outside through an incision in the cheek of the dog and sutured to the skin. On a dog thus prepared experiments can be started as soon as the orifice of the duct has grown to the skin and the gland has returned to its normal state after the operation (usually about one month).

Experiments are conducted in the following way: A metal funnel is pasted to the cheek of the dog with a special cement (Mendeleeff's), so that every drop of saliva from the fistula flows through this funnel into a graduated test-tube, hung to the end of the funnel.

For the investigation of the work of a salivary gland a definite quantity of a definite stimulant is introduced into the mouth of the dog (e.g., bread or 0.4 per cent HCl acid solution) and total quantity of saliva secreted under this stimulation is collected into the test-tube and measured. The duration of stimulation is always the same (30 sec.) and the experi-

* Read at the Twenty-fifth Annual Meeting, AMERICAN ROENTGEN RAY SOCIETY, Swampscott, Mass., Sept. 3–6, 1924.

ments are conducted always under the same conditions, so that the results obtained are quantitative. Such experiments are conducted repeatedly at definite short intervals of time, six experiments being conducted together in one series (in one day). Every portion of saliva is chemically analyzed after the experiment: for total solids, organic solids and ash.

For the estimation of the work of a salivary gland, in addition to the repeated introduction into the dog's mouth of a certain definite stimulant, thus permitting the study of the reflexes called "unconditioned" by Pavlov, there were also used repeated exhibitions to the dog of some definite stimulant, such as acid, producing Pavlov's "conditioned reflexes." Our experiments, therefore, include observations on both the "unconditioned" and the "conditioned" reflexes.

After the operated gland had returned to normal and its normal work had been determined, the gland was exposed to roentgen irradiation. Through a filter of 1 mm. copper plus 1 mm. aluminum, at a distance of 50 cm., with a voltage of 200,000, a dosage of 450 ma-min. was administered over the salivary glands, the remainder of the animal being thoroughly protected from direct radiation.

Physiological observations were made 24 hours, 48 hours, 72 hours, and one week after the treatment. Subsequently the tests were conducted once a week for a certain length of time depending on the results, and then once every other week. Each time there were carried out all the experiments employed in determining the normal work of the gland (i.e., six repeated conditioned stimulations and six repeated unconditioned stimulations).

Some of the dogs on which experiments were conducted had, in addition to the salivary fistulae, gastric fistulae through which the condition of the stomach was observed. In cases where the stomach was found in a catarrhal condition, experiments were omitted, because, as was shown by experiments of Boldyreff in 1916 (in Kazan), there is under such conditions an abnormally large production of saliva and the secretion of the submaxillary and sublingual glands is abnormally viscous (high percentage of mucus).

RESULTS OF THE EXPERIMENTS

Experiments were carried out on three dogs: two with fistulae of the parotid gland, one with both a parotid fistula and a fistula of the combined orifice of submaxillary and sublingual glands. In all three cases the results of the roentgen treatment over the salivary glands was a diminution of the salivary secretion.

Experiments on Dog No. 9. Male. Weight 26,000 grams. Fistulae: Parotid (operated Dec. 22, 1922), combined submaxillary and sublingual (operated Sept. 14, 1923), and gastric (operated May 7, 1923).

The normal secretory work of the parotid gland and of the submaxillary and sublingual glands was measured for the following irritants:

1. Unconditioned reflex on bread powder (repeated feeding, 4.0 gr. each portion).
2. Conditioned reflex on bread powder (repeated showings of 4.0 gr. portions).
3. Unconditioned reflex on 0.4 hydrochloric acid (repeated introductions of 10.0 c.c. portions of acid into the mouth).

After this the dog was treated with roentgen rays, and the secretory work of the salivary glands examined for the above indicated irritants, as described above.

The results for the unconditioned reflexes on bread powder are shown in Table 1 (all quantities of saliva are shown in c.c.).

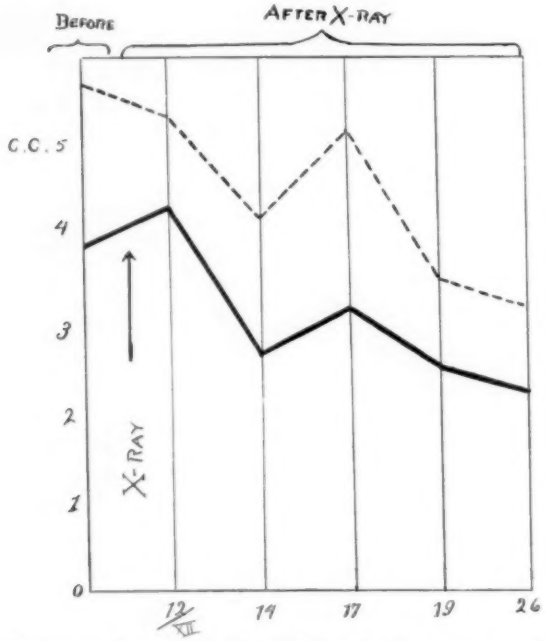
TABLE 1

Date of Experiment	Fistulae	
	Parotid	Submax. and Subling.
Normal one month before roentgen treatment	3.9	5.7
Roentgen treatment December 11, 1923		
Exper. after treatment Dec. 12	4.2	5.3
Exper. after treatment Dec. 14	2.6	4.2
Exper. after treatment Dec. 19	2.5	3.4
Exper. after treatment Dec. 26	2.2	3.3

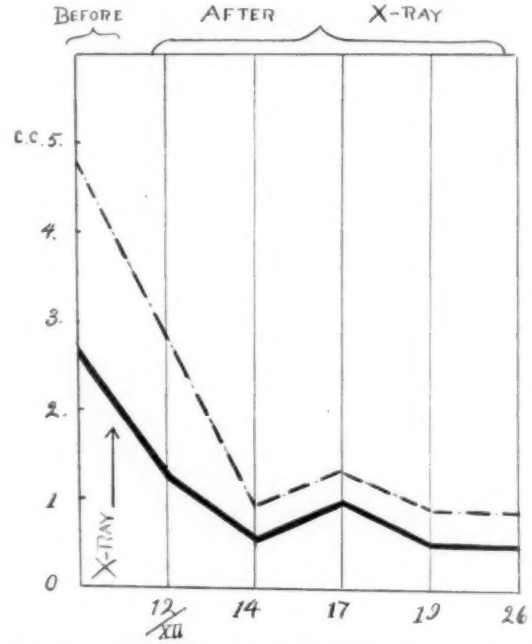
There is a marked decrease in the quantity of saliva secreted in the experiments after roentgen treatment. In one experiment, the total quantity of saliva before the roentgen treatment was 8.1 c.c. for parotid gland, and 12.7 c.c. for submaxillary and sublingual glands, whereas after the roentgen treatment these quantities became 7.3 c.c. and 9.1 c.c. respectively.

Curve 1 represents graphically the results shown in Table 1.

The results obtained in experiments with conditioned reflexes on bread powder are represented in Table 2 and Curve 11.



Curve 1. Dog No. 9. Unconditioned reflexes on bread powder (one feeding of 4.0 gr. of bread powder in each experiment). Solid line represents the variation in quantity of parotid saliva. Broken line represents the variation in quantity of sublingual and submaxillary saliva. Vertical numbers show quantity of saliva in c.c. Horizontal numbers, the dates of the experiments.



Curve 11. Dog. No. 9. Conditioned reflexes on bread powder (repeated showings of 4.0 gr. portions of bread powder). Solid line—parotid saliva. Broken line—submaxillary and sublingual saliva.

Here the decrease in the secretory work both of the parotid and of the submaxillary

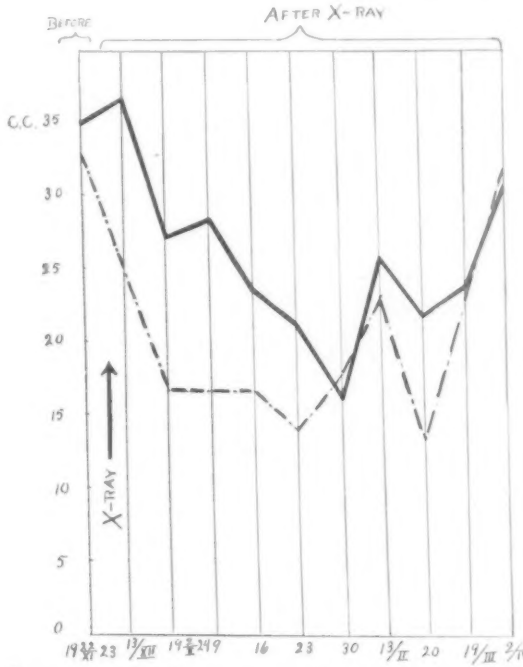
Table 2

Date of Experiment	Normal One Month Before Roentgen Treatment		Roentgen Treatment December 11, 1923.	December 12		December 14		December 17		December 19		December 26	
	Fistula			Fistula		Fistula		Fistula		Fistula		Fistula	
	Parotid	Submax. and Subling.		Parotid	Submax. and Subling.	Parotid	Submax. and Subling.	Parotid	Submax. and Subling.	Parotid	Submax. and Subling.	Parotid	Submax. and Subling.
1st Showing	1.0	1.2		0.8	1.2	0.3	0.4	0.7	0.6	0.4	0.6	0.4	0.6
2nd Showing	0.5	0.8		0.5	0.7	0.1	0.2	0.2	0.3	0.1	0.2	0.1	0.3
3rd Showing	0.3	0.6		0.1	0.3	0.1	0.2	0.1	0.3	0	0.1	trace	0
4th Showing	0.3	0.6		trace	0.2	0.1	0.1	0	0.1	0	0	0	0
5th Showing	0.3	0.5		0	0.1	0	0	0	0		0	0	
6th Showing	0.1	0.4		0	0	0	0		0				
7th Showing	0.1	0.4			0								
8th Showing	trace	0.2											
9th Showing	trace	0.1											
10th Showing	0	0											
11th Showing	0	0											
Total	2.6	4.8		1.4	2.5	0.6	0.9	1.0	1.3	0.5	0.9	0.5	0.9

TABLE 3
DOG NO. 9. UNCONDITIONED REFLEXES

Date of Experiment	Normal November 22, 1923		Roentgen Treatment December 11, 1923.	December 13, 1923		January 2, 1924		January 30, 1924		April 2, 1924	
	Fistula			Fistula		Fistula		Fistula		Fistula	
	Parotid	Submax. and Subling.		Parotid	Submax. and Subling.	Parotid	Submax. and Subling.	Parotid	Submax. and Subling.	Parotid	Submax. and Subling.
1st Introduction	3.8	4.8		6.7	4.2	5.1	3.1	1.5	2.6	3.4	2.9
2nd Introduction	5.5	5.5		6.9	6.2	3.5	2.2	2.7	3.2	4.4	3.9
3rd Introduction	6.2	4.8		6.9	4.2	4.5	3.5	3.1	2.4	4.7	5.0
4th Introduction	7.3	7.8		4.1	3.1	4.8	3.8	2.8	3.0	6.0	6.3
5th Introduction	5.3	3.9		6.2	4.3	4.1	2.1	3.9	2.8	5.3	5.7
6th Introduction	6.9	6.1		6.0	3.0	4.5	1.8	3.1	3.6	6.5	6.7
Total	35.0	32.9		36.8	25.0	26.5	16.5	17.1	17.8	30.3	30.5

and sublingual glands is very marked. Whereas before the roentgen treatment the total quantity of saliva secreted on showing of bread powder is 2.6 c.c. for the parotid and 4.8 c.c. for the submaxillary and sublingual glands, this quantity decreases within 15 days after the radiation to 0.5 c.c. for the parotid and 0.9 c.c. for the submaxillary and sublingual glands.



CURVE III. Dog No. 9. Unconditioned reflexes on 0.4 per cent HCl acid (repeated introductions of 10.0 c.c. portions of 0.4 per cent HCl acid into the mouth). Solid line—parotid saliva. Broken line—submaxillary and sublingual saliva.

Finally the results of experiments with repeated introductions of 10.0 c.c. portions of 0.4 per cent HCl are given in Table 3 and Curve III. In Table 3 it is seen that the work of the salivary glands decreased after the roentgen treatment more than twice, having reached the minimum about a month after the treatment, and then gradually increased until, three and a half months after the radiation, it returned to normal.

In the following tables (Tables 4, 5 and 6) are shown the results of chemical

TABLE 4
CHEMICAL ANALYSIS OF PAROTID SALIVA

	Normal One Month before Roentgen Treatment	Roentgen Treatment December 11, 1923	1923			
			Dec. 12	Dec. 14	Dec. 19	Dec. 26
Total Solids	1.00		0.56	0.66	0.74	0.72
Organic Solids	0.72		0.40	0.48	0.53	0.54
Ash	0.28		0.16	0.18	0.21	0.18

TABLE 5
CHEMICAL ANALYSIS OF SALIVA OF SUBMAXILLARY AND SUBLINGUAL GLANDS

	Normal One Month before Roentgen Treatment	Roentgen Treatment December 11, 1923	1923	
			Dec. 12	Dec. 14
Total Solids	0.98		0.80	0.91
Organic Solids	0.75		0.62	0.73
Ash	0.23		0.18	0.18

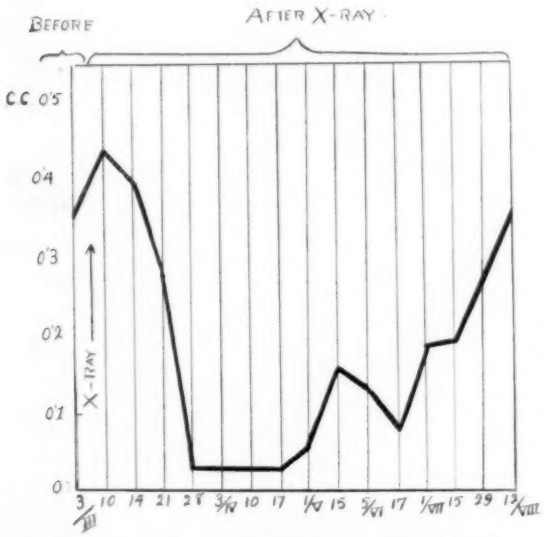
TABLE 6
CHEMICAL ANALYSIS OF SALIVA OF SUBMAXILLARY AND SUBLINGUAL GLANDS

	Normal November 22, 1923	Roentgen Treatment December 11, 1923	1923 Dec. 13	1924 April 2
Total Solids	0.99		0.86	1.05
Organic Solids	0.69		0.63	0.78
Ash	0.30		0.23	0.27

analysis of the saliva obtained from Dog No. 9 before and after roentgen treatment.

In all the experiments the amount of organic substances in the saliva became diminished after roentgen treatment. With bread powder, the amount of the total solids decreased after irradiation, but with HCl, the primary decrease was followed later by a return to normal and then an increase to even greater than normal (see Table 6). In the series of experiments with HCl the amount of inorganic substances (ash) was markedly increased after irradiation.

Experiments on Dog No. 6. Male. Weight 18,000 grams. Fistulae: Parotid (operated April 7, 1923) and gastric (operated June 27, 1923).



CURVE IV. Dog No. 6. Parotid fistula. Conditioned reflexes on 0.4 per cent HCl acid (repeated showings of 10.0 c.c. portions of 0.4 per cent. HCl acid).

The normal secretory work of the parotid gland was measured for conditioned and for unconditioned reflexes on 0.4 per cent HCl (repeated showings and repeated introductions into the mouth of 10.0 c.c. portions of 0.4 per cent HCl). Experiments with bread powder were not conducted on this nor on the following dog for the reason that these experiments proved unsuccessful on the first dog.[1]

Five days after the normal work of the parotid gland was measured, the gland was exposed to radiation by the technique and with the dosage already mentioned. Table 7 and Curve IV show the results of the radiation on the parotid secretion, in experiments with repeated showings of acid. The quantity of saliva secreted on showing of the acid to the dog decreased after the roentgen treatment and reached its minimum a month after the treatment. Then it gradually increased and returned to normal about five months after the beginning of the experiment.

Table 8 and Curve V show the results of experiments with repeated introductions of acid into the mouth of the dog. Here the radiation also very markedly diminished the secretory work of the parotid gland. A month after the treatment, the work of the gland reached its minimum, the quantity of saliva collected

[1] During the bread powder experiments on radiated dogs, a considerable quantity of bread powder clung to the teeth, the hard palate and in the back of the mouth, which ordinarily experimental animals are able to remove readily. Attention will be called again to this point.

TABLE 7

CONDITIONED REFLEXES

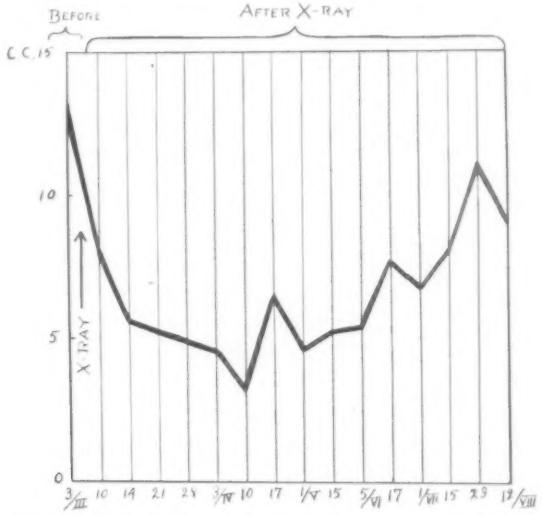
Parotid Gland

	Normal March 3	Roentgen Treatment March 8, 1924	March				April			May		June		July			August
			10	14	21	28	3	10	17	1	15	5	17	1	15	29	12
1	0.2		0.2	0.3	0.25	trace	trace	trace	trace	trace	0.1	0.1	trace	0.1	0.1	0.2	0.2
2	0 1		0 1	0 1	trace	0	0	0	trace	trace	trace	trace	trace	trace	trace	trace	0 1
3	trace		0.1	0	0	0	0	0	0	0	trace	0	trace	trace	trace	trace	trace
4	trace		trace	0	0					0	0	0	0	trace	trace	trace	trace
5	0		0								0		0	0	0	0	0
6	0		0											0	0	0	0
7																	

during the experiment was reduced to only one-fourth (25 per cent) of the normal. Then, it began to increase and returned nearly to the normal five months after the radiation.

TABLE 8
SALIVARY SECRETION. UNCONDITIONED REFLEXES

	Normal March 3	Roentgen Treatment March 8, 1924	March 10	March 14	April 10	June 5	July 15	July 29
1	2.0		0.8	0.8	0.4	1.3	1.4	2.2
2	2.3		1.0	0.6	0.4	0.2	0.8	0.9
3	2.3		1.5	1.6	0.4	0.5	0.7	2.2
4	2.5		1.6	1.0	0.5	1.4	1.6	1.9
5	2.4		1.1	0.7	0.6	1.0	0.9	2.8
6	2.4		1.4	0.9	1.2	0.9	2.1	1.7
Total..	13.9		8.4	5.6	3.5	5.3	7.5	11.7



CURVE V. Dog No. 6. Parotid fistula. Unconditioned reflexes on 0.4 per cent HCl acid (repeated introductions of 10.0 c.c. portions of 0.4 per cent HCl acid into mouth).

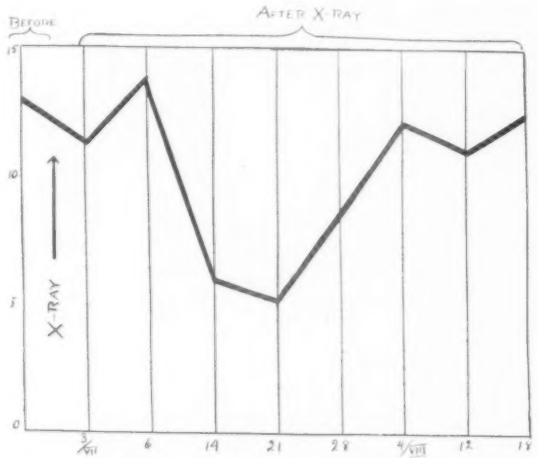
Chemical analysis shows that the amount of organic substances in the saliva did not diminish after roentgen treatment and the amount of ash remained nearly the same as before the radiation.

Experiments on Dog No. 17. Female. Weight 20,000 grams. Fistula: Parotid (operated March 18, 1924).

On this dog conditioned and unconditioned reflexes on acid were determined, as the measure of normal secretory work of the parotid gland. Then the dog was treated with roentgen radiation in the manner and with the dosage afore-mentioned, and the change in the salivary secretion observed, as shown in Tables 9 and 10, and Curve VI. The results are in general identical with those obtained on Dogs No. 9 and 6, except that the secretion reached the minimum and returned to normal a little earlier than in the other dogs.

TABLE 9
DOG NO. 17. PAROTID FISTULA. CONDITIONED REFLEXES
(0.4 per cent HCl acid, repeated showings)

	Average Normal	Roentgen Treatment July 1, 1924. Dose: 450 ma-min.	1924 July 3	July 6	July 14	July 21	July 28
1	0.6		1.2	0.8	0.3	0.2	0.2
2	0.6		1.1	0.7	0.2	0.1	0.2
3	0.3		0.7	0.5	0.1	0.1	0.2
4	0.3		0.8	0.4	0.1	0.1	0.2
5	0.3		0.6	0.3		0.1	0.2
6	0.4		0.7	0.2			0.2
7	0.3		0.5				0.1
8	0.3		0.5				0.1
9	0.3		0.5				
10	0.1		0.4				



CURVE VI. Dog No. 17. Parotid fistula. Unconditioned reflexes on 0.4 per cent HCl acid (repeated introductions of 10.0 c.c. portions of 0.4 per cent HCl acid into mouth).

TABLE 10
DOG NO. 17. PAROTID FISTULA. UNCONDITIONED REFLEXES
(0.4 per cent HCl acid, 10.0 c.c. repeated stimulation)

	May 19, 1924	Roentgen Treatment July 1, 1924. Dose: 450 ma-min.	1924 July 3	July 14	July 21	July 28	Aug. 18
1	2.0		1.7	0.7	0.7	1.5	1.5
2	2.5		2.2	0.6	0.7	1.2	2.0
3	2.3		1.7	0.8	0.6	1.3	2.2
4	2.1		2.4	1.0	0.8	1.4	2.0
5	2.5		2.0	0.7	0.8	1.4	2.2
6	2.8		1.5	1.0	0.8	1.6	2.4
Total	14.2		11.5	4.8	4.4	8.4	12.3

The results of the chemical analysis of the saliva, shown in Table 11, are identical with those obtained on the previous animals.

TABLE 11

DOG NO. 17. PAROTID FISTULA. CHEMICAL ANALYSIS (0.4 per cent HCl acid)

	Treatment: Roentgen July 1, 1924. Dose: 450 ma-min.	Average Normal		July 14, 1924	August 12, 1924
Total Solids...		1.10		1.11	1.13
Organic Solids.		0.83		0.90	0.86
Ash.....		0.27		0.21	0.27

CONCLUSIONS

1. Large doses of filtered, short wave length roentgen rays applied to the salivary glands very markedly diminish (four to five times) their secretory work. The quantity of saliva secreted on a certain definite irritation decreases after radiation therapy, reaching the minimum in about one month after the treatment, and slowly returns to normal.

2. The composition of the saliva is affected by roentgen treatment, but at the present the change is not clear and further experiments in this direction will be done.

3. The decrease of the salivary secretion is for both the conditioned and unconditioned reflexes.

4. Very notable is the marked degree of the diminution in the secretory activity, amounting to four or five times, so that the glandular activity was reduced to one-fourth, or one-fifth, of the normal in all the animals observed.

5. This great decrease in salivary secretion, though in part due to diminished sensibility of the buccal mucosa, cannot be altogether explained in this manner, for, although the conditioned reflexes follow the unconditioned reflexes (as Pavlov has shown), they are not affected directly by the change of sensibility of the mouth.

6. The action of roentgen rays on the centers of salivary secretion is doubtful. Therefore, it must be concluded that the salivary glands themselves are affected by exposure to the rays.

7. It appears advisable to examine the salivary glands microscopically at such time as their secretory work has reached the minimum after radiation therapy if one is to make satisfactory histological studies concerning the influence of radiation. This minimum of secretory activity occurs usually in three to four weeks after radiation and lasts about one month. Under such precautions, histological studies will decide definitely how the tissue of the salivary glands is affected by exposure to roentgen rays. In one of our dogs (No. 9) which died from an accidental cause after the termination of our experiments, no changes were found on microscopic study (A. S. Warthin) of the parotid, probably because at that time the secretory work of the salivary glands in this animal had already returned to normal. Until now no such histological examinations have been reported, made with these facts in mind, and hence there is some doubt as to the interpretation of the histological studies already in print on this point.

8. Experiments are in progress relative to the influence of deep roentgen treatment on the secretory function of the stomach. In these experiments the decrease is found to be even more marked than with the salivary glands. A report with full details will be published shortly.

B. THE EFFECT OF DEEP RADIATION ON THE SENSIBILITY OF THE BUCCAL MUCOSA

During experiments with Dog No. 9, employing repeated feedings of bread powder, it was observed that after roentgen treatment a large quantity of bread powder, cemented together into lumps and tenacious masses by the saliva, remained for a long time in the mouth, between the teeth, on the hard palate, and in the back parts of the mouth. The animal tried to get rid of these pieces, as it always did before the roentgen treatment, and as all dogs usually do, but now with little success. This filling of the mouth with pieces of bread powder moistened with saliva became such a hindrance to this phase of the experimentation, that it was necessary to discontinue the experiments with bread powder and to use HCl as the stimulant.

Later it was also observed on this and other dogs on which experiments with repeated showings and introductions of HCl into the mouth were performed, that after roentgen treatment the animals excited by the showing of acid not less than before roentgen treatment, no longer showed excitement and did not resist when this acid was introduced into their mouths.

It was at once supposed that the cause of these phenomena was a diminution of the sensibility of the mucosa of the mouth and tongue due to the radiation.

In order to test the validity of this supposition a special series of exact experiments on four dogs was conducted in which the sensibility of the different parts of the mouth was measured by means of a Dubois-Reymond induction coil, before and after irradiation. It was found that roentgen treatment does definitely diminish the sensibility of the mouth in experimental dogs.

Another series of experiments was carried out on human beings, on six patients who had received roentgen therapy of various dosage and at various periods of time before the tests. Their sensibility of the mouth was compared with that of a young person (non-smoker) never treated with roentgen radiation, the sensibility of whose mouth was taken as normal.

These tests on the human have also indicated that roentgen treatment intensely diminishes the sensibility of the mucosa of the mouth and tongue, and that the sensibility tends to return later to the normal, the time required depending on the intensity of the radiation. However, it is a question if the normal sensibility is ever completely restored after therapeutic applications of roentgen rays in the dosage required for malignant disease.

The decrease of sensibility of the mucosa of the mouth following roentgen treatment and its tendency to return to the normal runs parallel with the diminution of the work of the salivary glands after roentgen treatment and the later restoration of this function, as reported in the first part of this communication.

Table 12 and Curve VII show a typical series of observations on one of the observed dogs. Repeated observations on other dogs gave quite identical results.

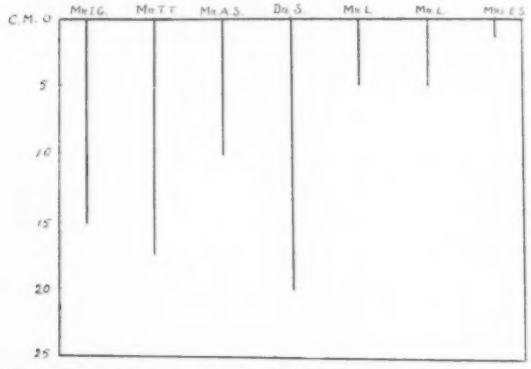
For convenience, the readings (distances between the coils in cm.) corresponding to the normal sensibility of different parts of the mouth were called zero, and the sensibility after roentgen treatment was denoted by the difference between the reading for sensibility after the irradiation and that for normal sen-

CURVE VII. Decrease of sensibility of mouth after roentgen treatment and the restoration of the sensibility. Dog. No. 19 (see Table 12).

TABLE 12
ROENTGEN TREATMENT MAY 1, 1924

Date of Experiment	Sensibility of				Sum
	Upper Gum	Nose	Lower Lip (Inside)	Lower Gum (Soft)	
May 1	0	0	0	0	0
3	−2	−1	−1	0	4
5	−2	−2	−1	−0.5	−5.5
11	−2	−2	−2	−0.5	−6.5
15	−3	−2	−2	−0.5	−7.5
22	−2	−2	−2	0	−6
29	−1	−2	−2	−0.5	−5.5
June 5	−1	−1	−2	−0.5	−4.5
19	0	−1	−1	−0.5	−2.5
July 3	0	−1	0	−0.5	−1.5
17	0	−1	0	−0.5	−1.5
31	0	−1	0	−0.5	−1.5
Aug. 14	0	−1	0	−0.5	−1.5
28	0	−1	0	0	−1

sibility. For example, if 17 cm. was the reading for the normal sensibility of some part of the mouth, and 16 cm. the reading corresponding to the sensibility of the same part of the mouth after roentgen treatment, then the sensibility after the treatment was denoted as −1 cm. In Table 12 one sees a marked diminution of the sensibility of the mouth after radiation and its later return toward the normal.



CURVE VIII. Decrease of sensibility of mouth on human beings due to roentgen treatment (see Table 13).

Table 13 and Curve VIII show the details of our observations on a series of six human beings. The method of testing the sensibility was the same as in the preceding series of experiments. The results show definitely the effect of large doses of radiation in intensely diminishing the sensibility of the buccal and lingual mucosa.

CONCLUSIONS

1. Large doses of filtered roentgen radiation diminish intensely the sensibility of the mouth. The change is not permanent, for the sensibility later improves, but evidently it is not completely restored.

2. The decrease of sensibility and its tendency toward restoration are directly dependent upon the dosage of roentgen rays administered.

3. This decrease of general sensibility of the mouth is an experimentally observed fact, but a logical conclusion from this fact is that there is a decrease in specific sensibility, that is, the sensation of taste. This is in accordance with the commonly observed disorders of taste reported by our patients in clinical work undergoing analogous treatment. A definite plan has been devised for an exact experimental study of this point and a further report will be made on it later.

4. The specific sensibility of the nose and other sense organs about the face is

TABLE 13.

SENSIBILITY OF MOUTH (HUMAN BEINGS)

Date of Experiment	Name	Radiation			Sensibility of						
		When	Lesion	Dose	Upper Gum	Lower Gum	Upper Lip	Lower Lip	Tip of Tongue	Middle Tongue	Sum
March, 1924	A. B.	Never	None	None	0	0	0	0	0	0	0
March, 1924	J. G.	June, 1923 Aug. 1923 Nov. 1923 Apr. 1924 Aug. 1924	Ca. Right tonsil	Repeated very heavy.	−2	−2	−2	−1	−6	−2	−15
March, 1924	T. T.	Feb. 1924 Mar. 1924	Ca. Neck	Repeated very heavy.	−3	−2	−3	−2	−6	−2	−18
March, 1924	A. S.	Mar. 1922	Ca. Lower lip	Single massive dose.	−3	−2	0	−1	−3	0	−9
Mar. 31, 1924	Dr. S.	Sept. 1922 Oct. 1922 Dec. 1922 Feb. 1924 Apr. 1924	Ca. Neck recurrent from tongue.	Repeated very heavy.	−2	−3	−3	−3	−7	−2	−20
Mar. 31, 1924	Mr. L.	1921, 1922 1923, 1924	Ca. Forehead	Small scattered doses on salivary glands.	0	0	−2	−1	−3	+1	−5
May 8, 1924	Mr. L.	Re-check	Ca. Forehead	Small scattered doses on salivary glands.	−1	+1	−2	−1	−3	+1	−5
May 26, 1924	Mrs. S.	Apr. 1924	Epithelioma nose	Practically none to mouth or throat.	0	0	−1	0	+1	+1	−1

in all probability similarly diminished after roentgen treatment. Exact studies on this point are required.

5. On dogs there was observed a decrease of the ability to control the various muscular movements associated with mastication and deglutition. This phenomenon must depend upon the influence of the roentgen rays upon the peripheral motor nerves controlling these muscles.

A SUMMARY OF THE EFFECTS OF REPEATED ROENTGEN-RAY EXPOSURES UPON THE HUMAN SKIN, ANTECEDENT TO THE FORMATION OF CARCINOMA*

BY S. BURT WOLBACH, M.D.

BOSTON, MASSACHUSETTS

THIS brief summary is based upon a review of the human material collected by Dr. C. A. Porter, which is included in his paper of 1909, and material from subsequent cases, to which I have added experimental tissues from guinea pigs and rats. In the experimental exposure of animals to roentgen rays, the earliest demonstrable histological change in the skin is a very striking swelling of the collagen of the corium and subcutaneous tissue. The bundles of collagen fibrils swell, the fibrils coalesce, producing a compact, refractive, greatly thickened corium. After a single exposure, this effect in guinea pigs became visible microscopically in from forty-eight to seventy-two hours, and reached a maximum in from six to eight days. Coincident with this microscopic change there is a marked gross shrinkage of the skin which can easily be observed if the area of exposure is outlined by means of a strong dye-stuff. This effect on the collagen seems more or less specific and may be observed in the collagen in the walls of large blood vessels and in the stroma of the appendages of the skin. Some of the connective tissue cells are destroyed; many survive, as is evidenced by mitotic division a few days following exposure. These changes in the collagen may be explained if we assume that the osmotic pressure is increased because of decomposition products. The duration of the latent period of roentgen-ray "burn" would then be the time required for equilibrium to be established between the altered collagen and the tissue liquids. Last summer Dr. M. J. Schlesinger and I endeavored to test this theory experimentally, by comparing the amounts of water taken up by radiated skin (immediately after exposure) with that taken up by normal skin. In general our results verified the theory, but as we have just discovered that our range of experimental error was greater than we supposed, we cannot present definite conclusions. Another method, that of comparing the conductivities *in vivo* of radiated and non-radiated areas of skin, may be tried in the future.

The epidermis shows no change until the swelling of the collagen has occurred. We believe that the lesions of the epidermis are secondary to the obliteration of lymphatics and capillaries (possibly a lowered permeability of the collagen contributes) caused by the changes (swelling) of the collagen. The altered connective tissue does not regenerate, but new connective tissue is laid down by surviving and ingrowing fibroblasts and this is the process that leads to the shrunken indurated condition of chronic roentgen-ray dermatitis. This reaction in connective tissue explains many conditions found in chronic roentgen-ray dermatitis. It takes place not only in the corium of the skin but also

* Read at the Twenty-fifth Annual Meeting, AMERICAN ROENTGEN RAY SOCIETY, Swampscott, Mass., Sept. 3–6, 1924.

in the walls of blood vessels, accounting for the thickening and eventually for the occlusion of blood vessels.

corium, because only in the superficial layers is there actual necrosis which calls forth a polymorphonuclear reaction. These

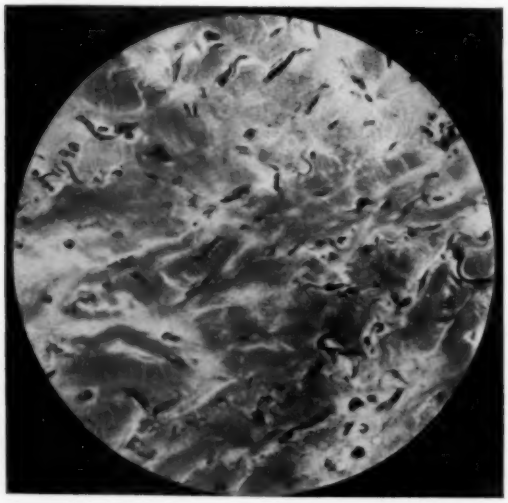


FIG. 1. Chronic roentgen-ray dermatitis, recent reaction in the connective tissue of the corium, swelling of collagen, loss of cells, persistence of elastic fibers.

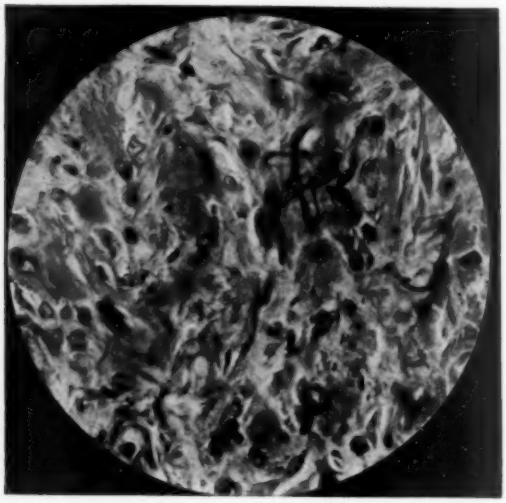


FIG. 2. Repair of radiated collagen, showing the ingrowths of fibroblasts and early deposition, indicated by pale areas surrounding cells, of new collagen.

Changes in the epidermis are visible on and after the fourth day and consist of swelling of the cells and mitotic division.

minute necrotic gaps in experimental tissues may be seen to be filled with proliferated epidermis at the end of twelve

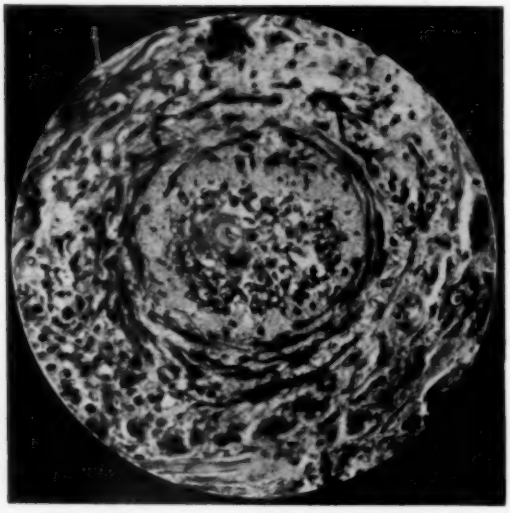


FIG. 3. Arteriole obliterated by successive roentgen-ray exposures. A repetition of decomposition of collagen and deposition of new collagen by ingrowing fibroblasts.

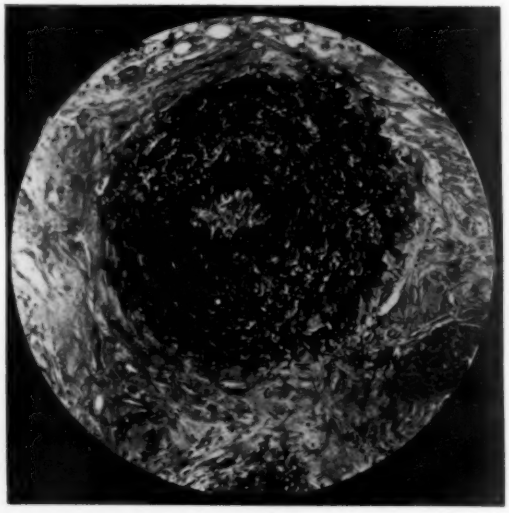


FIG. 4. Obliterated arteriole, human skin; elastic tissue stain.

These experimental tissues furthermore show that the maximum effect of the radiation is upon the superficial layers of the

days, following a single exposure. A more or less permanent increase in thickness of the corium is brought about by the multi-

plication of fibroblasts and the formation of new collagen between the old collagen bundles. These observations in animals are comparable, as far as they go, with those observed in human skin. Just what the sequences in human skin are following repeated exposures at varying intervals of time must be left to speculation. It is safe to assume that a repetition of the effect described above occurs. There is no need to speculate, however, upon the objective findings in human skins that have reached the condition known as chronic roentgen-ray dermatitis and these changes may be summarized as follows:

1. Complete loss of the appendages of the epidermis.

2. Replacement of the normal collagen by a peculiarly dense hyaline collagen, rich in elastic fibres and poor in cells (Figs. 1 and 2).

3. Obliterative processes in blood vessels of the corium and subcutaneous tissues (Figs. 3 and 4).

4. Necroses of varying size in the corium immediately beneath the epidermis (Figs. 5, 6, and 7). In the earlier stages of chronic roentgen-ray dermatitis, these necroses are usually in the neighborhood of thrombosed telangiectases. In later stages of roentgen-ray dermatitis the telangiectases may be nearly entirely absent.

5. In response to the necroses of the corium, reparative proliferation on the part of the epidermis. It is frequently possible to see regeneration of epidermis extending beneath thrombosed telangiectases (Figs. 8 and 9) and even small masses of necrotic corium. These small necroses containing thrombosed telangiectases become completely separated from the skin by the layer of regenerated epidermis and persist for a time as dry dark colored spots—the "coal spots"—until cast off. The significance of these processes lies in the fact that it is invariably present

FIG. 5. Rarefied collagen, early stage of necrosis of the skin.

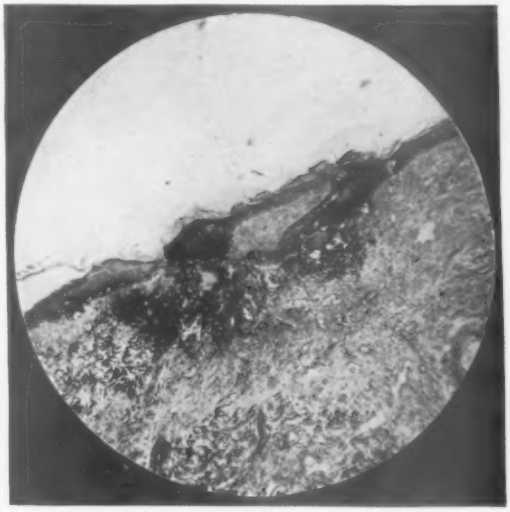


FIG. 6. A small necrosis before regeneration of epidermis had taken place.

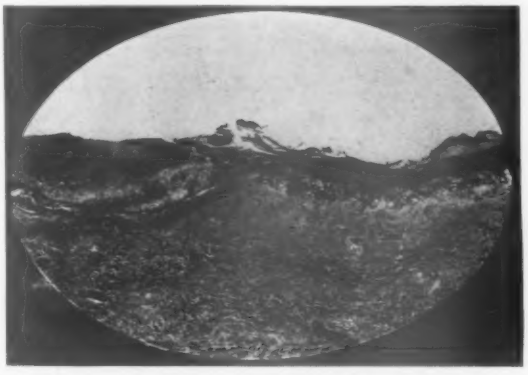


FIG. 7. Necrosis of the corium. On the left the epidermis has regenerated beneath the necrosis. On the right necrosis is beginning, although the epidermis is still intact.

in chronic roentgen-ray dermatitis, even after the lapse of many months or several years since the last exposure to radiation.

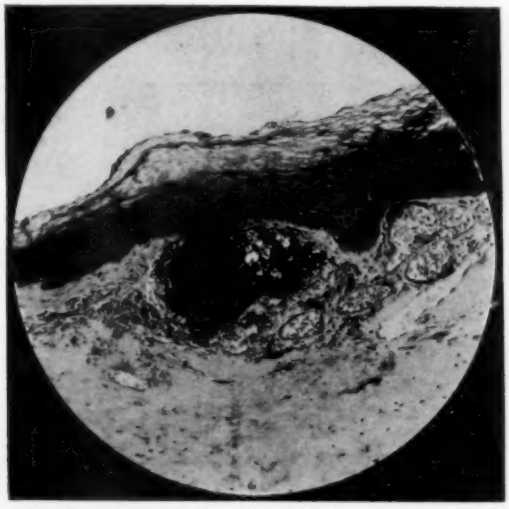


FIG. 8. Thrombosed telangiectasis in contact with the epidermis.

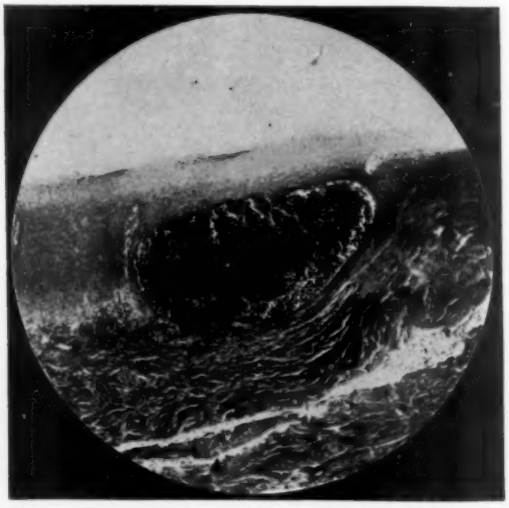


FIG. 9. Regeneration of epithelium beneath a thrombosed telangiectasis.

Detailed studies show that the immediate initial change occurring in one of these necroses is a focus of localized edema immediately beneath the epidermis (Fig. 5), which in the 1909 article I referred to as an area of rarefication. The epidermis becomes separated from the viable corium by an edematous layer containing only necrotic cells and often infiltrated with fibrin. It has been impossible to demonstrate the actual vascular changes responsible for individual necroses but the sequences suggest very strongly that the cause is a gradual obliteration of the capillary circulation brought about by shrinkage of the collagen. There is practically no attempt at repair by organization of these minute sub-epithelial necroses owing to the pathological condition of the deeper lying

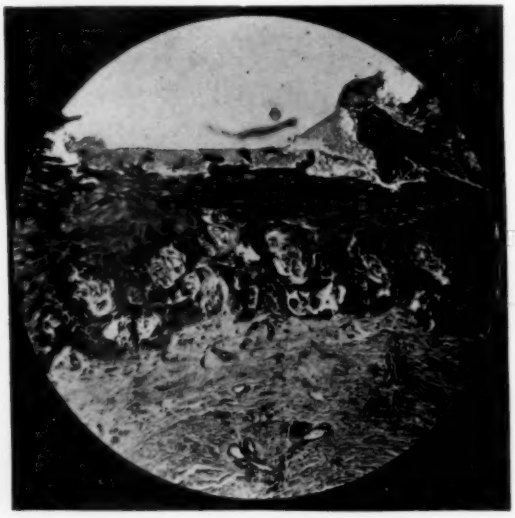


FIG. 10. Early degenerative changes in epidermis.

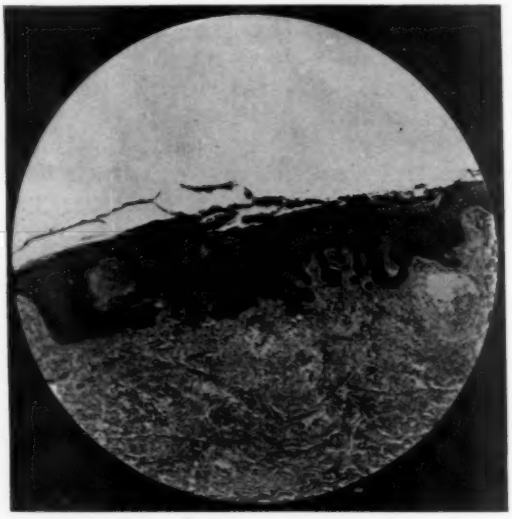


FIG. 11. Regenerated and thickened epidermis that has repaired a superficial necrosis of the corium, to illustrate the downward migration of epidermis.

connective tissues. The gap is speedily covered by regeneration of epidermis so that the effect of the occurrence of these necroses is to produce a downward migration of the epidermis (Figs. 10 and 11) and the epidermis in these regions becomes altered probably because of the imperfect nutrition it receives from the peculiarly cicatrized corium. The effect upon the epidermis is evidenced by a thickening and imperfect differentiation into keratin so that the superficial cells remain attached one to the other, resulting in thick accumulations of imperfectly keratinized fused epithelial cells (Fig. 12). This I believe to be the origin of the keratoses so common in chronic roentgen-ray dermatitis (Fig. 13).

A factor which undoubtedly comes into action is the maintenance of the continuity of the epidermis over small areas by the proliferation of epithelial cells in the adjacent better nourished periphery, thus instituting a mechanism whereby constant epithelial proliferation is maintained.

In the consideration of the origin of epidermoid carcinoma in chronic roentgen-ray dermatitis, the outstanding fact of importance is that conditions are continually occurring which call forth proliferative activities on the part of the epidermis greatly in excess of the rate of normal proliferation or that which can be induced by conditions not involving the corium. We stress the observation that the acquisition of malignant properties is not a sudden one, that it is gradually acquired in the course of years. We believe that the epidermis is a transparent tissue and is not injured by the passage of the rays. Reactions of the epidermis we believe are secondary to lesions in its supporting tissue, the corium. For many years following injuries by roentgen rays, the epidermis proliferates and behaves as it does in normal reparative processes. The acquisition of malignant properties follows sustained proliferative activities in contact with an abnormal supporting tissue.

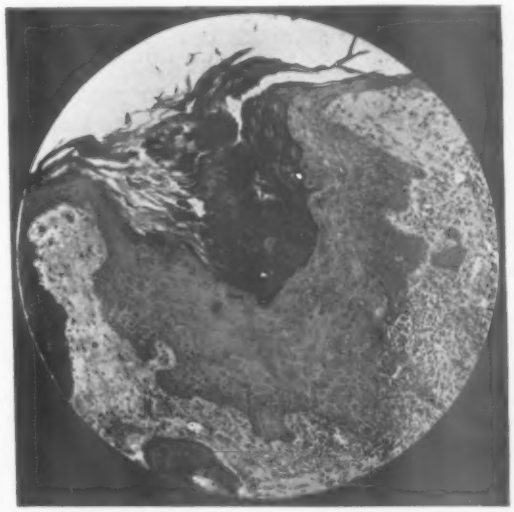


FIG. 12. Small keratosis taking origin in regenerated epithelium which has repaired a small gap in the corium. For the persistence of this thickened epidermis it is necessary to assume an unusual activity on the part of the epidermis occasioned by the deficient nutrition.

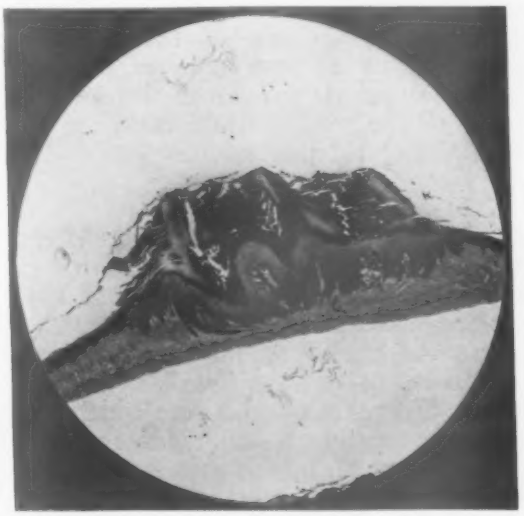


FIG. 13. A fully developed keratosis. While the keratosis extends above the level of the skin, it has taken origin beneath the level of the epidermis, and illustrates the atypical growth of epithelium which has migrated downward and which is able to sustain itself on an inadequately supporting connective tissue.

THE END RESULTS IN ROENTGEN-RAY TREATMENT OF CUTANEOUS CANCER

BY HENRY H. HAZEN, M.D., AND EUGENE R. WHITMORE, M.D.

WASHINGTON, D. C.

THE object of this paper is to show the final results of the roentgen-ray treatment of cutaneous cancer. During the past ten years some 200 private cases of basal cell cancer have been thoroughly treated by this method; 160 of these have been followed for periods varying from one to eight years. No cases are included in which other methods of therapy were employed. In a large number of cases biopsy immediately followed by cauterization of the wound has established the diagnosis beyond question.

HISTORICAL

Although cancer of the breast had been treated by roentgen radiation as far back as 1897, by Gocht,[1] it was not until 1899 that Stenbeck[2] presented the first case of skin cancer healed by this agent. At the same meeting of the Swedish Medical Society, Sjogren showed a case which was still under treatment. The earliest reports in Europe were by Sederholm, Schotz, Taylor, Ferguson and Sequeira. In America, Merrill and Johnson,[3] of Washington, were the first to apply roentgen rays in cases of cutaneous malignancy. Their paper is still a classic and should be read by everyone who is interested in this subject. Beginning with 1901, many papers upon this subject appeared, the more important of which are mentioned in the books of Pusey and Caldwell,[4] and MacKee.[5]

In regard to the technique of administration there has been a great change. In the old days of the gas tube, exposures were given from two to five times a week until the lesions were healed, or a dermatitis developed. In face of many odds, Pusey[6] developed a successful technique and consistently showed that irradiation would cure a high percentage of superficial cancers. Pusey's success was undoubtedly due to his employment of a comparatively small number of rather heavy treatments. In 1912 MacKee[7] introduced into America treatment by large measured doses, pastilles and a Holzknecht radiometer being employed to measure the doses. MacKee[8] has further modified and improved the method of measurement by showing that an exact estimation of the spark gap, time, milliamperage and distance, when an interrupterless transformer and Coolidge tube are used, will obviate the necessity of employing the rather unsatisfactory pastilles. Within the past two years there has been a great tendency to increase the focal skin distance in order that an increased dose will reach the deeper tissues. The use of high voltage machines and of copper filters is advocated by some, but to the authors this appears like using a club to kill a butterfly.

DISCUSSION OF MULTIPLE LESIONS

Unfortunately the number of patients and the number of lesions are not the same. One hundred and sixty individuals afflicted with a total of 244 basal cell cancers have been studied. In 3 instances patients showing multiple lesions were healed of all but one, hence the percentage of cures in the case of lesions is considerably higher than if the individual alone were considered. As a result it seems best to employ two tables, one for patients, and one for lesions. One woman suffered from no fewer than 30 superficial growths, best known as the Bowen type of epithelioma. Another woman had 7 of these growths. A third showed 12 very small basal cell nodules upon the face.

SELECTED AND UNSELECTED CASES

Naturally the same results cannot be expected in small superficial growths of short duration and in large and old growths which have penetrated deep into the tissues and most likely have involved the cartilage and periosteum. In the same way patients who have had much treatment with either roentgen rays or radium are almost impossible to cure. A third extremely unsatisfactory group consists of

those suffering from cancer of the ear. Sixteen of the 160 patients fell into one of these three groups, so as a consequence the selected patients number 144. The end results of treatment are shown in Tables I and II.

TABLE I
END RESULTS IN SELECTED AND UNSELECTED PATIENTS

	Cured	Relapse Cured Roentgen Radiation	Relapse Not Cured Roentgen Radiation	Improved	Not Improved	Total
Unselected patients	128 or 80.0%	7 or 4.3%	12 or 7.5%	2 or 1%	11 or 6.8%	160
Selected patients	128 or 88.8%	7 or 4.8%	7 or 4.8%	0	2 or 1.3%	144

TABLE II
END RESULTS IN SELECTED AND UNSELECTED GROWTHS

	Cured	Relapse Cured Roentgen Radiation	Relapse Not Cured Roentgen Radiation	Improved	Not Improved	Total
Unselected growths	209 or 85.5%	7 or 2.8%	15 or 6.1%	2 or 0.8%	11 or 4.5%	244
Selected growths	209 or 92.9%	7 or 3.1%	7 or 3.1%	0	2 or 0.9%	225

The word "cured" means there has been no relapse in from one to ten years. "Relapse cured roentgen radiation" means that a recurrence of the growth was cured by subsequent roentgen treatment. "Relapse not cured roentgen radiation" signifies that a return of the lesion was not amenable to irradiation or that it was treated by some surgical procedure. The word "improved" means that the major portion of the growth was cured, leaving only a small area that was dealt with by other methods. "Not improved" means that irradiation has no beneficial effect upon the condition.

Table III is self-explanatory.

TABLE III
RESULTS IN PATIENTS ACCORDING TO NUMBER OF YEARS UNDER OBSERVATION

	Patients Cured	Relapse Cured Roentgen-ray	Relapse Not Cured Roentgen-ray	Improved	Not Improved	Total
6 or more years	21–90%	..	1	..	1	23
5 years	26–81%	1	4	..	1	32
4 years	19–82%	1	2	..	..	22
3 years	23–85%	..	1	..	3	27
2 years	14–53%	4	4	2	2	26
1 year	25–83%	1	..	..	4	30
	128	7	12	2	11	160

TABLE IV
GROWTHS ACCORDING TO SEX

Number of growths in men..... 110 in 91 patients
Number of growths in women..... 134 in 69 patients
Excluding 2 multiple cases in women 92 in 67 patients

Table IV shows the number of lesions occurring in the two sexes. It will be noticed that basal cell cancer is more frequent in the male sex, an observation in accord with accepted beliefs. Women are more prone to multiple lesions.

The results in women are slightly better than those in men. MacKee's statistics are similar in this respect. The explanation would seem to be that women are more prone to seek early treatment and hence stand a better chance of cure, no matter what method of treatment is applied. Table V will reveal the results.

TABLE V
RESULTS ARRANGED ACCORDING TO SEX

Unselected Patients

	Male	Female
Cured	72 = 79.1%	63 = 91.3%
Not cured	19 = 20.9%	6 = 8.7%

Selected Patients

	Male	Female
Cured	72 = 92.3%	63 = 95.4%
Not cured	6 = 7.7%	3 = 4.6%

Table VI shows the age incidence of the patients.

TABLE VI
GROWTHS ACCORDING TO AGE

Age	Male	Female	Total
20–30	2	1	3
31–40	4	10	14
41–50	27	16	43
51–60	22	27	49
61–70	25	9	34
71–80	10	4	14
81 up	1	2	3

Table VII shows the results according to the age of the patient. It will be noted that age seems to exert no special influence upon the results of treatment.

TABLE VII
END RESULTS IN PATIENTS ACCORDING TO AGE

	Cured	Recurrence Cured Roentgen Radiation	Recurrence Not Cured Roentgen Radiation	Improved	Not Improved	Total
20–30	2–66%	1	..	..	..	3
31–40	12–82%	..	2	..	..	14
41–50	33–76%	3	3	1	3	43
51–60	41–83%	1	3	1	3	49
61–70	26–76%	2	2	..	4	34
71–80	11–78%	..	2	..	1	14
81 up	3–100%	..	..	..	..	3
	128	7	12	2	11	160

RESULTS ACCORDING TO VARIETY OF LESION

It is convenient to divide the basal cell cancers into eight groups. The commonest variety encountered is the *rolled edge*, in which there is a raised indurated edge, which is sometimes continuous and sometimes composed of a ring of nodules. The central portion is usually ulcerated, but there may be a slightly fungous growth. These lesions usually develop rather slowly.

The *Bowen type of cancer* is also known as the eczematoid type, the psoriasiform type, and mistakenly by some as extra-mammary Paget's disease, which in reality is an absolutely distinct affection. The recent American literature consists of articles by Bowen,[9] Morrow,[10] Ketron,[11] and Mount.[12] These lesions are most frequent upon the trunk or limbs. These begin as small, slightly scaly, sharply defined itching patches which in no way resemble malignancy. Later a slightly indurated edge develops and ulceration with the formation of a distinct keratosis may occur. With the development of malignancy a curious waxy appearance is the rule.

Superficial nodules are hard lesions, usually showing but little ulceration and often resembling keloids.

Superficial ulcers are usually due to the breaking down of a superficial plaque. Naturally ulcer formation always suggests a deeper growth than does a nodule.

In the cicatrizing type the growth is extremely superficial and has healed in the center while there is a ring of active nodules around the edge. At times one or two nodules may persist in the scar. These lesions even when large heal very well after radiation, comparatively light treatments being required. Naturally one would hesitate to give many heavy treatments over an extensive scar.

Fungous growths simply mean that the tumor mass has grown out instead of in. As a general rule this soft growth does not require curettage but melts away rapidly after one or two treatments.

Deep nodules often extend to underlying periosteum or cartilage and are much more difficult to handle than are any of the preceding groups.

Deep ulcerative lesions give the worst results of any of the eight groups as the lesions have usually invaded deep structures. MacKee's results are similar to the ones recorded in this paper. Tables VIII and IX show how these may be expected to heal.

TABLE VIII
END RESULTS IN GROWTHS ACCORDING TO VARIETY

	Cured	Recurrence Cured Roentgen Ray	Recurrence Not Cured Roentgen Ray	Improved	Not Improved	Total
Rolled edge	93	2	4	1	3	103
Bowen type	39	..	..	..	..	39
Superficial nodule	33	1	2	..	..	36
Superficial ulcer	25	2	..	..	2	29
Cicatrizing	2	..	..	..	..	2
Fungous	3	..	..	..	..	3
Deep nodule	5	1	3	..	..	9
Deep ulcer	9	1	6	1	6	23
	209	7	15	2	11	244

TABLE IX
PERCENTAGE OF CURES ACCORDING TO VARIETY (UNSELECTED)

	Per Cent
Rolled edge	92.2
Bowen type	100.0
Superficial nodule	94.4
Superficial ulcer	93.1
Cicatrizing	100.0
Fungous	100.0
Deep nodule	66.6
Deep ulcer	43.4

RESULTS ACCORDING TO LOCATION OF LESIONS

A study of the end results according to the location of the basal cell growths speedily reveals that cancers located in certain areas do not do nearly so well as those located in others. Much the poorest results were obtained in treating cancers of the ear. Out of 8 growths only 3 were permanently cured and 2 of these were

extremely small and of short duration. The results obtained by desiccation or by the use of the actual cautery are so much quicker and better that it seems folly to employ irradiation upon cancers of the ear. Both Sutton,[13] and Schultz[14] have likewise had the same experience. On the other hand, MacKee reports 3 failures and 1 relapse out of 14 cases. MacKee's comparatively poor results with cancer situated in the eyebrow have not been duplicated in our experience. In the canthi and lids the percentage of cures was relatively low; this was naturally due to the invasion of cartilage. MacKee also records a high percentage of relapses, and other radiologists have had the same experience. The comparatively poor showing made with growths situated in the nasofacial and nasolabial fold is due to the fact that several of the most advanced lesions had begun in these spots. The high percentage of cures upon the trunk and limbs is unquestionably due to the large number of Bowen type of lesions encountered in these localities. Growths situated upon the forehead, nose and cheeks have usually given excellent results. Tables x and xi graphically record the results.

TABLE X

UNSELECTED END RESULTS IN GROWTHS ACCORDING TO THE LOCATION

Location	Cured	Recurrence Cured Roentgen Ray	Recurrence Not Cured Roentgen Ray	Improved	Not Improved	Total
Scalp	1	..	..	..	..	1
Forehead	13	..	..	..	..	13
Rt. temple	8	..	2	..	..	10
L. temple	5	..	1	..	..	6
Rt. ear	2	..	..	..	2	4
L. ear	1	..	..	1	2	4
Rt. outer canthus	1	..	..	..	1	2
Rt. inner canthus	7	..	1	..	..	8
L. outer canthus	2	..	..	1	..	3
L. inner canthus	2	..	..	..	..	2
Lower lid	2	..	..	..	1	3
Nose	51	3	3	..	2	59
Rt. nasofacial fold	4	..	..	..	1	5
L. nasofacial fold	3	..	2	..	..	5
Rt. nasolabial fold	..	1	..	..	..	1
L. nasolabial fold	1	..	..	..	1	2
Rt. cheek	27	2	..	..	..	29
L. cheek	33	..	3	..	..	36
Upper lip	2	..	1	..	..	3
Lower lip	1	..	..	..	1	2
Chin	6	..	2	..	..	8
Neck and throat	11	1	..	..	..	12
Trunk	9	..	..	..	..	9
Arms	13	..	..	..	..	13
Hands	3	..	..	..	..	3
Legs	1	..	..	..	..	1
	209	7	15	2	11	244

TABLE XI

PERCENTAGE OF CURES ACCORDING TO LOCATION

Location	Per Cent
Forehead	100.0
Temples	81.2
Ears	37.5
Canthus and lids	77.7
Nose	89.0
Nasal fold	69.2
Cheeks	93.8
Lips	60.0
Neck and throat	91.0
Chin	75.0
Trunk	100.0
Limbs	100.0
Hands	100.0

RESULTS ACCORDING TO THE DURATION OF LESIONS

Naturally growths of long duration cannot be expected to heal so well as lesions which have lasted but a short time, and have not had a chance for extensive invasion. Tables xii and xiii will record these results.

TABLE XII

RESULTS ACCORDING TO DURATION OF LESIONS (UNSELECTED)

Duration	Cured	Recurrence Cured Roentgen Ray	Recurrence Not Cured Roentgen Ray	Improved	Not Improved	Total
Less than 1 yr	50	1	1	..	1	53
1–2 yrs	40	4	4	1	2	51
2–3 yrs	17	1	1	..	2	21
3–5 yrs	11	1	2	..	2	16
5 yrs. up	10	..	4	1	4	19
	128	7	12	2	11	160

TABLE XIII

PERCENTAGE OF CURE ACCORDING TO DURATION OF LESIONS

Duration	Per Cent
Less than 1 yr	96.2
1–2 yrs	86.3
2–3 yrs	85.7
3–5 yrs	75.0
5 yrs. up	52.6

RESULTS ACCORDING TO SIZE OF LESIONS

Small lesions almost invariably respond much better than large ones. Our favorable experience with large lesions has been confined to growths of the Bowen variety, or of the superficial cicatrizing type. Tables xiv and xv give a brief summary of the results.

TABLE XIV

RESULTS ACCORDING TO SIZE OF LESIONS (UNSELECTED)

Size	Cured	Recurrence Cured Roentgen Ray	Recurrence not Cured Roentgen Ray	Improved	Not improved	Total
Under ½ in.	112	..	..	..	1	113
½–⅞ in.	74	6	6	..	4	90
1–1¼ in.	14	..	6	..	2	22
1½–2 in.	2	1	3	1	..	77
2 in. and over	7	..	..	.	4	12
	209	7	15	2	11	244

TABLE XV

PERCENTAGE OF CURES ACCORDING TO SIZE OF LESIONS

Size	Per Cent
Under ½ in.	99.0
½–⅞ in.	89.0
1–1¼ in.	63.6
1½–2 in.	42.8
Over 2 in.	58.3

THE EFFECTS OF PREVIOUS TREATMENT

The cases have been studied with a view to the effects of caustics, of roentgen radiation, and of radium treatment upon our results. It is a striking fact that cases which have had previous roentgen or radium treatment are extremely difficult to handle with irradiation. MacKee's experience has been identical. On the other hand, the effect of caustic pastes has not had any great effect. Table XVI will reveal the statistics.

TABLE XVI

EFFECTS OF PREVIOUS TREATMENT

	Percentage of Cures
Caustics	85.6
Roentgen radiation	52.3
Modern radium	57.1

STATISTICS FROM THE LITERATURE

While there are numerous statistics which deal with the treatment of superficial cancer by the method of fractional doses the majority are of no value; no distinction is made between basal and prickle cell cancer and the cases have not been followed for a sufficiently long space of time. A few statistics, which apparently have real merit, are given in Table XVII.

TABLE XVII

STATISTICS OF TREATMENT FROM THE LITERATURE

	Per Cent Cured
Pusey	72 (including prickle cell neoplasms)
E. G. Williams[15]	81
Sequeira[16]	55
C. M. Williams[17]	56

Turning to the modern heavy dose method we again find paucity of reliable statistics. It is true that many authors claim to have cured from 96 to 99 per cent of all cases but a careful reading of their articles hardly warrants their claims. MacKee's statistics are excellently prepared and are worthy of study and emulation. Table XVIII gives the statistics of modern treatment.

TABLE XVIII

STATISTICS OF MODERN TREATMENT FROM THE LITERATURE

Dollaway[18]	Cured 99% (including prickle-cell neoplasms)		
Dachtler[19]	Cured 90% (less a few recurrences)		
MacKee	Total patients treated 644 (unselected cases)		
	Lost sight of after first treatment	183	
	Patients finishing treatment	461	
	Clinical cures	421	(91%)
	Improved	33	(7%)
	Unimproved	7	(2%)
	Clinical cures	421	
	Lost sight of within 6 mos.	139	
	Cases followed over 6 months	282	
	Relapses	36	= 13%
	Cures	244	= 87%
	Cases followed over 1 year	242	
	Relapses	34	= 14%

It will readily be seen that MacKee's figures are very similar to ours.

COMPARISON OF RESULTS FROM IRRADIATION AND OTHER THERAPEUTIC MEASURES

Unfortunately the authors have been unable to find any complete statistics as to the results obtained from radium. The figures given by Morrow and Taussig,[20] Quigley,[21] Sweitzer,[22] Harrison,[23] Quick,[24] and the British Radium Institute would seem to indicate that the results obtained from roentgen rays and radium are practically identical. MacKee is also of this opinion. Practically all writers express the opinion that an occasional basal cell cancer which does not respond to roentgen radiation will respond to radium. On the other hand, the authors have cured two neoplasms with roentgen rays after the failure of radium by supposedly excellent workers. It seems to us that the two agents have

about the same value. One advantage of radium which has never been emphasized is that it can be used at the home of patients. Surgery gives practically the same results as those quoted by MacKee and the other writers. Some years ago, one of us[25] (H. H. H.) reported 64 patients with basal cell cancer treated by excision, who had been followed for more than three years. There was a percentage of permanent cures of 86 in unselected cases and of 93 in the selected cases. Surgery affords a much quicker method of eradicating the disease than does irradiation. The linear scar from a well done excision is

FIG. 1. Patient shows a cicatrizing basal cell cancer.

almost as inconspicuous as the best roentgen-ray result. However, irradiation has certain great advantages; it can easily reach areas where surgical removal is difficult such as the nasofacial and nasolabial folds and eyelids. Owing to the natural desire of the surgeon to leave a good result there is always a tendency to make too narrow an excision, a difficulty that does not confront the roentgenologist. And finally the cosmetic results from irradiation are almost uniformly excellent.

The actual cautery has been in use for years, but unfortunately there are no statistics regarding the permanent cures obtained by means of it.

One of the newer forms of treatment is desiccation or electrocoagulation. These methods have been warmly advocated for a number of years by Clark,[26] Pfahler,[27] Wyeth,[28] and others. Unfortunately we have no final results recorded by any of the users of this method. At the same time there can be no doubt that it is a quick

FIG. 2. Patient shows five basal cell cancers, one which was so deep as to defy irradiation. The case is especially interesting because a lymph node removed from the right side of neck showed metastasis.

and sure means of eradicating small lesions, and that at times brilliant cures of extensive lesions have been made. In a late paper Stevens[29] reports that by a combination of this method with either roentgen rays or radium he has been able to cure 100 per cent of the small basal cell growths and 90 per cent of the large lesions. We have found the method especially valuable in dealing with deep recurrences and in lesions of the ear involving the cartilage, and are much inclined to believe that it will be a serious rival to all other methods.

Sherwell[30] believes that he has cured about 90 per cent of unselected cases of basal cell cancer by the vigorous use of the curette and cauterization with the acid nitrate of mercury. Arsenic or zinc chloride pastes were long popular with many dermatologists; Robinson thought that it was possible to effect a cure in 90 per cent of all cases. However, the indiscriminate use of these pastes by cancer quacks, and

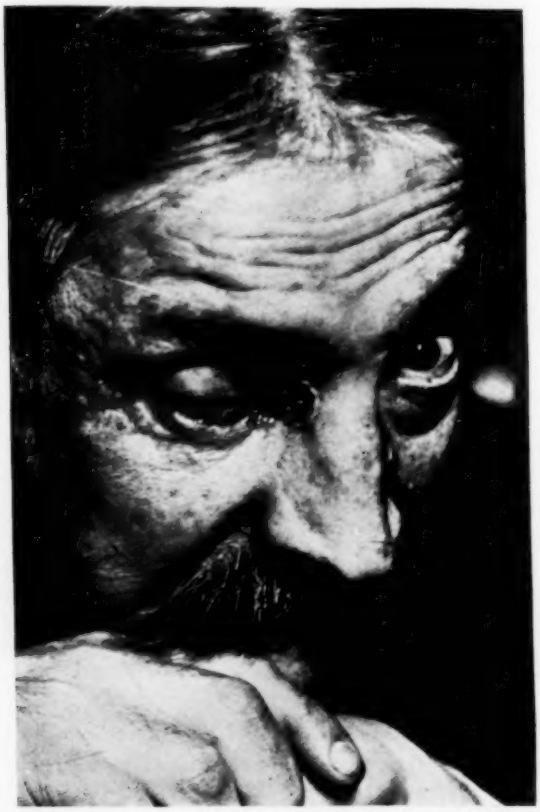


FIG. 3. An extensive basal cell cancer involving bone and the entire lower lid was entirely cured despite the fact that patient was a markedly anemic morphine addict.

the great pain caused by them, have led to their abandonment in the hands of all skillful practitioners. The cautery or desiccation are much kindlier methods of producing the same results, especially as no man dares use them without some type of anesthetic.

The electric needle, carbon dioxide snow, superficial curettage and burning with superficial caustics are mentioned only to be condemned.

At the present time it would seem that roentgen radiation can justly be considered as equal in value to radium, the knife or fulguration, and infinitely superior to any of the other methods. In addition it is what one observer has reported as the "most sympathetic method," for it is painless and requires but a few minutes of the patient's time.

DISCUSSION OF SOME UNUSUAL CASES

From the preceding discussion and tables it might easily be inferred that rather large lesions never did well as the result of

FIG. 4. A rapidly growing squamous cell cancer extending into the parotid has been well six years.

irradiation. This is not always the case as the following brief case reports will show:

CASE I. Extensive basal cell cancer of eighteen years' duration involving the entire left orbit. Six heavily filtered treatments, cross firing, resulted in the apparent complete eradication of the disease. Unfortunately the patient was then lost sight of.

CASE II. Dipsomaniac and morphine addict with hemoglobin of 25 per cent had an extensive basal cell cancer in the right internal canthus adherent to the bone and involving the ciliary margin of both lids. This case was

permanently cured although no apparent skin reaction could be obtained from irradiation. Even a dose of 4 H. unfiltered units gave no erythema.

CASE III. A man over eighty years of age had a deep nodular growth about 2 inches in diameter on the bridge of his nose. He had had previously a small basal cell cancer in the same location, which disappeared after one treatment. This growth was perfectly cured by 2 filtered cross fire treatments.

CASE IV. A white woman came into the office because of an extremely small, somewhat pedunculated, soft nodule on the upper rim of her ear. Excision showed basal-cell cancer, although it would never have been suspected had one of us (H. H. H.) not had 2 similar cases in the past. As the section showed that the growth had not been entirely removed roentgen radiation was used, resulting in a permanent cure.

FIG. 5. A squamous cell cancer originating from porokeratosis has been well over three years, although there was a lymph node involvement. This is the first reported case of cancer developing from porokeratosis. Photograph from cast made by Dr. J. F. Wallis.

The last case is reported to show that it is occasionally very difficult to differentiate between benign and malignant growths; the smaller the growth, the more difficult the diagnosis. In this connection it might be mentioned that upon 3 occasions the authors have mistaken a superficial malignancy for a common wart. This seems a ridiculous error to make; but it has been done despite the fact that after the first experience we recognized this possibility.

TECHNIQUE

The first few cases reported were treated with a coil and a water cooled gas tube, but the majority were treated with a Coolidge tube and interrupterless transformer. Until three years ago the small basal cell growths were treated with the following technique: Spark gap 7½ in., focal skin distance 8½ to 9 in., time 2 to 2¼ min., 4 ma., no filter. During the past three years the same technique has been employed except that the time has been increased to 3 or 3½ min. A careful review of patients treated by the two techniques reveals the fact that the percentages of cures and of recurrence are identical. In other words *a heavier dose has no advantage in producing either temporary or permanent cures.*

During the past two years all growths of any depth has been treated with a focal skin distance of 12 inches, in order to secure a larger dose at a depth. In all cases showing an appreciable deep induration or ulceration, from 1 to 3 mm. of aluminum was employed as filter. A small series of superficial cases was treated with filtration but apparently this is of no particular advantage or disadvantage.

The standard interval between doses has been three weeks. However, if there is any erythema the treatment is postponed until this has disappeared. The intervals between treatments are rather longer in the filtered cases. Ordinarily about ¼ inch margin has been given the growth. In 3 instances there has been a recurrence just

at the edge of the irradiated area, and we are inclined to believe that the treatment should include an area at least ⅜ of an inch beyond the suspected limits of the growth. In treating growths upon the nose we have found it wise to insert into the nostril a small cigarette roll of light lead rubber and then to spread this out as much as possible with a pair of forceps. This serves to protect a considerable proportion of the mucous membrane. In the same way, the gums should be protected when treatment is given over the lips.

We have always made it a routine to give at least one treatment after all signs of malignancy have disappeared. Table XIX shows the number of treatments necessary to effect a cure.

TABLE XIX
NUMBER OF TREATMENTS NECESSARY

No. Treatments	Cases	Per Cent
1	4	3.0
2	29	22.6
3	31	24.2
4	42	32.8
5	9	19.0
6	4	
7	2	
8	4	
10	3	

Out of 33 favorable cases which had received one or two treatments we have had 4 recurrences, or 12 per cent, which is higher than the percentage of failures occurring in this class of growth with from three to four treatments. Hence we believe *that every case of superficial cancer should receive at least three treatments.* Kingery[31] has described a method of radiation by which carefully graduated doses will keep the tissues in a saturated state. We have tried his method upon 2 cases of cutaneous cancer and have found the skin reaction excessive. MacKee has had the same experience. Recently Keith[32] has recommended that a tumor be irradiated with rays of varying lengths. We have tried practically the same technique in about a dozen instances but could detect no difference in the results from those secured by our usual methods.

SEQUELAE

Unpleasant results from irradiation are extremely rare. In 15 instances there have been a few telangiectases. These are much more apt to occur when a large rather than a small area is irradiated, and are probably a purely compensatory phenomenon; for deeper vessels were frequently destroyed.

No trouble has been encountered from roentgen-ray ulceration. However, we have seen several cases in which the use of various stimulating preparations, notably phenol and orthoform has resulted in painful and long continued ulceration. *Patients must always be instructed to use no medication whatever upon the irradiated areas without the knowledge and consent of the roentgenologist.*

There is usually a small scar over the entire irradiated area, which is due to a shrinking of the fibrous tissue, as a rule this is barely noticeable, although usually slightly lighter in color than the surrounding tissue. We have never heard a single complaint from a patient because of it.

FAILURES AND RECURRENCES

In this series of cases there have been 34 instances where a cure did not result. In 13 instances the growths did not completely heal and in the remainder there was a recurrence after an apparent cure. Only 2 recurrences occurred later than twelve months after the last radiation, one after two years and one after eighteen months. MacKee notes a considerably higher percentage of late recurrence, 42 per cent, varying in time from the second to the fourth year. This discrepancy may possibly be explained by the extremely close watch we have kept upon all patients during the first year.

Because of this extremely low percentage of late recurrences we have felt that for all practical purposes we may list any case as cured which shows no recurrence within one year.

Of the failures 25 were in men and 9 in women. The influence of the size of the lesion, of its duration and location have already been discussed. One notable fact is the influence of previous treatment. Out of the cases which had had previous roentgen radiation only 52 per cent were cured. *It is obvious that previous irradiation exerts a very bad effect upon prognosis.*

In these cases the patients gave good cooperation in 24 instances, fair cooperation in 3 and very poor in 7.

Our explanation for failure is as follows:

TABLE XX

Growths too extensive	3
Cartilage involvement	5
Poor cooperation	4
Previous radiation	3
Growth in scar tissue	1
Too small an exposure	2
Apparently favorable cases	10
	34

A further study of the 10 apparently favorable cases shows that 2 had had previous irradiation, although this had not been excessive, and 3 patients had rather deep and old lesions, one of ten years' duration and one of seven. However, we felt that these cases should have resulted in cures.

It is a striking fact that when the cancer cells are in cartilage or in scar tissue, and radiation practically always produces scar tissue, the results of treatment are poor.

PRICKLE CELL CANCER

Under ordinary circumstances a prickle or squamous cell cancer is an extremely dangerous affliction. The growths tend to infiltrate deeply and sooner or later almost invariably metastasize. However, there are two varieties which are not so malignant. One is the prickle cell wart, which is a much raised growth with practically no infiltration below the subcutaneous tissue. The second is the flat lip cancer. Our general feeling has been that better results have been obtained by surgery than by irradiation; hence we have comparatively few cases to report. Twenty-two cases, 19 in men and 3 in women have been followed. The results are as follows.

TABLE XXI

	Cured	Recurrence Healed	Failures	Total
Lip	5	..	3	8
Ear	1	..	2	3
Face	2	..	4	6
Body	..	..	1	1
Hand	2	1	..	3
Vulva	..	..	1	1
	10	1	11	22

Of the 10 cured cases, 2 have been well for six years, 1 for five years, 1 for four years, 3 for three years, 1 for two years, 2 for one year.

Of the failures 3 were hopeless at the start, while 2 were extremely small growths of short duration, in which here was every reason to anticipate success. However both of these growths spread rapidly despite heavy radiation. Of the 11 failures, 9 refused to respond to treatment while 2 healed locally only to recur in draining lymph nodes.

It is usual to irradiate the neighboring lymph glands. In 12 instances we have been called upon to treat lymph nodes which were already involved; in 5 instances this treatment was successful, while in 7 instances the cancer could not be conquered.

MacKee gives no figures of his own. Bisserie[33] reports 24 cases of lip cancer with 14 cures. Boggs[34] claims 80 per cent of cures in early cancer of the lip and above 50 per cent of advanced cases, but he does not give statistical results. Various other writers have reported from 50 to 98 per cent of cures. *We do not feel that the results of the roentgen-ray treatment of advanced prickle cell cancer are encouraging.* Apparently rather better results are obtained by a combination of desiccation, roentgen rays and radium. It will take more time to determine this point. Broders'[35] statistics of the ultimate result of surgery for lip cancer appear sufficiently good to give the roentgenologist pause.

Broders has shown that the cases of prickle cell cancer with many pearls do much better than the cases where practically no pearls are present. It has been claimed that basal cell cancers may turn into the squamous cell type and in exceptional instances this may be true, but we have encountered no such cases.

SECONDARY CANCER OF THE SKIN

This type of cancer is the result of metastases from a primary visceral lesion. Six such cases have been treated and in all of them the growths temporarily disappeared. In 3 cases of carcinoma en cuirasse there was an apparent dissolution of the scar tissue by the rays with the almost immediate development of wide spread metastases. *It would seem possible that in*

certain instances irradiation can result in the liberation of cancer cells and the speedy demise of the patient.

MODE OF ACTION OF RADIATION UPON CARCINOMA

There has been a very general assumption upon the part of clinicians that the cure of cancer depended upon the direct destruction of the cancer cells by the rays. This likewise affected the laboratory men who spent much time in searching for a lethal dose. Seitz,[36] Wood and Prime,[37] Kimura,[38] Wedd and Russ[39] and other workers have announced their results in killing cultures of cancer cells by means of roentgen rays and also have announced that in experimental mouse cancer irradiation of a cancer graft would frequently prevent a take. Wood and Prime found that cancer cells could be killed *in vitro* by approximately four erythema doses of roentgen rays, given continuously. The advent of the new high voltage work brought the announcement from certain of the German clinics that there was a definite lethal dose for both sarcoma and carcinoma.

Within the past two years however, there has been a distinct reaction from this point of view; Opitz,[40] Hesse,[41] Perthes,[42] Loeb,[43] and many others believe that the tissue reaction is the essential factor in the cure. The work of Murphy and his collaborators at the Rockefeller Institute has taken two forms: First, the demonstration that the circulating lymphocytes might play some part in cancer immunity,[44] and secondly mouse cancer grafts would not take when the site for the graft had previously been irradiated, while the radiation of the grafted cells did not prevent a take.[45]

Ewing[46] well summarizes the histological changes produced by radium and roentgen rays. The ordinary radium and roentgen-ray dosage used on basal cell cancer does not kill the cells; it causes a regression of the tumor and a proliferation of normal tissue. The nuclei of the cancer cells are changed; they are swollen, there are no mitotic figures and the chromosomes are disarranged. Loeb says that these changes are due to a changed osmotic tension. There is an increase in lymphocytes and plasma cells and a few leucocytes usually are present. Frequently there is a proliferation of fixed tissue cells.

Medium filtered doses produce about the same changes but there is some superficial necrosis. There is some reacting proliferating tissue which grows in and replaces the malignant cells.

Buried needles of radium give a surrounding caustic result and a distant gamma effect with tissue reaction.

A heavy radium pack acts practically as a pure caustic. There are marked anemic infarctions.

Heavy, filtered, deep, cross-fire radiation acts largely by producing an atrophy of the vessels.

The work of Joly,[47] Barclay,[48] Friedrich,[49] Bragg and Bragg,[50] and of Keetman and Mayer[51] has made every one believe that the irradiation results are due to secondary rays generated in the tumor substance. It is interesting to note that in the work of Wedd and Russ and of Wood and Prime secondary radiation produced no effect upon the cancer cells *in vitro*.

There is considerable experimental work to indicate that small doses of roentgen rays have a stimulating effect. There is increased metabolism, increased cell movement and increased proliferation. That plant tissue may be stimulated has been shown by Redfield and Bright,[52] Gager[53] and Koernike.[54] The first division of eggs is hurried, according to the observations of Lazarus-Barlow,[55] Richards,[56] and Packard.[57] But this is followed by a later depression.

There are numerous theories as to the mechanisms of action. The following outline will briefly indicate them.

1. Cancer cells are directly killed.
   - (*a*) Caustic action.
   - (*b*) Nuclear destruction.
   - (*c*) Changed osmotic tension.
   - (*d*) Changed H-ion concentration (Loeb).
   - (*e*) Ferment activity (Packard, Roth, and Morton[58]).
   - (*f*) Split proteins from round cells (quoted by Perthes).

2. The vitality of cancer cells is so lowered that bodily resistance overcomes

them (Stephens and Theilhaler, quoted by Perthes).

3. Local increase in the defensive power of the host.

(*a*) Local tissue reaction (Parkhurst,[59] Murphy, Kok[60]).

(*b*) Migration of lymphocytes.

4. Stimulation at a distant point produces antibodies (Caspari, and Fraenkel).

The most important experimental work is that of Murphy and his collaborators, who have shown that in certain varieties of mouse cancer a cancer graft will take even though it has been irradiated, but if the site of inoculation be previously irradiated the graft will not take. However, if the graft be made deep down in the subcutaneous tissue beyond the wall of lymphocytes attracted by the irradiation the graft will take. In other words, the tissue reaction produced by irradiation is apparently responsible for the immunity.

The relationship of lymphocytes to immunity has been challenged by various observers including Millet and Mueller,[61] Mottram and Russ,[62] Prime,[63] and Sittenfield.[64]

Loeb has given an exhaustive review of the effect of irradiation upon cancer cells, with an extensive bibliography, and comes to the conclusion that local immunity may be due partly to the migration of lymphocytes, partly to local tissue reaction, and partly to a new growth of fibrous tissue. As bearing upon certain of the above points a number of clinical observations have been made.

1. Too heavy treatments will reduce bodily resistance (Perthes, and Opitz).

2. Light treatments frequently give better results.

3. Cancer cells may exist even in the leather-like induration of a severe burn (Opitz).

Skin cancers afford ideal opportunities for a study of the effects of irradiation. We wish to record the following observations as affording some slight evidence that the tissue reaction is responsible for the destruction of the carcinoma, and that the cells are not directly killed by the rays.

1. We have had just as good results from 1¼ or 1½ unit doses as from 2 or 2½ unit doses; this is in a large series of cases.

2. Too heavy treatment may reduce resistance; we have seen cancers spread very rapidly after a second degree burn.

3. Cancer cells in cartilage or in scar tissue as a rule will not respond to irradiation. A study of the sections from several of these cases shows that there is no tissue reaction, and no infiltration of lymphocytes or fixed tissue cells.

4. In one instance a basal cell tumor that could not be clinically changed by irradiation was excised, and although nuclei and chromosomes showed extensive damage, the growth was extending despite a marked tissue reaction.

From all of these observations certain practical conclusions seem obvious. A patient should receive more than one or two treatments. Too heavy treatments should not be given. Irradiation should reach well around the edges of the growth as well as to its depth. There is no use in mixed doses. It is folly to waste time in irradiating cancer in the cartilage, or in scar tissue. There is apparently a scientific basis for preoperative irradiation. *The cure of cancer depends upon a proper stimulation of tissue reaction.*

CONCLUSIONS

1. Of unselected patients, 84 per cent were cured of basal cell cancer.

2. Of selected patients, 93 per cent were cured.

3. Of unselected growths, 88 per cent were cured.

4. Of selected growths, 96 per cent were cured.

5. Skin cancer is more common in men than in women.

6. The results in women are a little better than in men.

7. The age of the patient does not affect the result.

8. Deep ulcers or nodules do not give as good results as other types of lesions.

9. Growths of the ears yield poor results.

10. Growths in the cartilage yield poor results.

11. Early lesions give better results than do old.

12. Small lesions give better results than do large.

13. Cases previously treated with roentgen rays or radium yield about 50 per cent of cures.

14. Roentgen-ray results are the same as those secured from radium or from excision.

15. A 1½ unit dose is as effectual as a 2½ unit dose.

16. There is a rather high percentage of recurrences when only one or two treatments are given.

17. Cosmetic results are splendid.

18. Only in large growths may telangiectases appear.

19. Of recurrences, 94 per cent occur in the first year.

20. The causes of failure are; deep invasion of cartilage; poor cooperation; localization in scar tissue and previous radiation.

21. Of the prickle cell cancers 45 per cent were cured.

22. Of cancerous glands 41 per cent were cured.

23. Irradiation may destroy some scar tissue and set free cancer cells.

24. The mode of action of irradiation is through its effect upon the healthy tissue, not upon the cancer.

BIBLIOGRAPHY

1. Gocht. Therapeutische Verwendung der Röntgenstrahlen. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1897–98, i, 14–22.
2. Stenbeck, Thor. Ein Fall von Hautkrebs, geheilt durch Behandlung mit Röntgenstrahlen. *Mitt. a. d. Grenzgeb. d. med. u. Chir.*, 1900, vi, 347–349.
3. Merrill and Johnson. *Phila. M. J.*, 1900, vi, 1089.
4. Pusey and Caldwell. The Roentgen Rays in Therapeutics and Diagnosis. Philadelphia, 1921.
5. MacKee, G. M. *X*-Rays and Radium Treatment of Diseases of the Skin. Lea and Febiger, Philadelphia, 1921.
6. Pusey. Trans. Sixth Internat. Dermat. Congress, N. Y., 1907, i, 498.
7. MacKee, G. M., and Remer, J. The external causes of skin diseases. *N. York M. J. (etc.)*, 1913, xcviii, 513–516.
8. MacKee, G. M. Roentgen ray and radium in basal cell epithelioma. Am. J. Roentgenol., 1919, vi, 119.
9. Bowen, J. T. Precancerous dermatoses; a study of two cases of chronic atypical epithelial proliferation. *J. Cutan. Dis. incl. Syph., N. Y.*, 1912, xxx, 241–255. Precancerous dermatoses; a sixth case of a type recently described. *J. Cutan. Dis. incl. Syph., N. Y.*, 1915, xxxiii, 787–802.
10. Morrow, H., and Lee, A. W. Bowen type of epithelioma. *J. Cutan. Dis.*, 1918, xxxvi, 1.
11. Ketron, L. W. Superficial epitheliomas. *J. Cutan. Dis.*, 1919, xxxvii, 22.
12. Mount, L. B. Bowen type of epithelioma. *Arch. Dermat. & Syph.*, 1921, iv, 769.
13. Sutton, R. L. Carcinoma of the external ear. *J. Am. M. Ass.*, 1920, lxxiv, 88.
14. Schultz. *X*-Ray Treatment of Skin Diseases. Rebman Co., New York, p. 151.
15. Williams, E. G. *Trans. Am. Roentgen Soc.*, 1907, Cincinnati, O., p. 34.
16. Sequeira, J. H. Treatment of cancer by radiotherapy and by radium. *Arch. Roentg. Ray, Lond.*, 1909–10, xiv, 75–80.
17. Williams, C. M. *X*-Ray treatment of cutaneous epithelioma. *Am. J. M. Sc., Phila.*, 1905, cxxix, 465–474. Late results of the *x*-ray treatment of cutaneous epithelioma. *Med. Rec., N. Y.*, 1906, lxx, 907.
18. Dolloway, L. M. Superficial epithelioma. Am. J. Roentgenol., 1917, iv, 619.
19. Dachtler, H. W. Tumors of the face. Am. J. Roentgenol., 1917, iv, 599.
20. Morrow, Howard, and Taussig, Laurence. Statistics and technique in the treatment of malignant disease of the skin by radiation. Am. J. Roentgenol. (etc.), 1923, x, 212–218.
21. Quigley, D. T. The treatment of superficial cancer, with statistics and technique. Am. J. Roentgenol. (etc.), 1923, x, 161–162.
22. Sweitzer, S. E. Skin cancer. *J. Am. M. Ass.*, 1917, lxix, 179.
23. Harrison, F. C. Radium treatment of skin cancer. *Canadian Pract.*, 1924, xlix, 169–171.
24. Quick, Douglas. Radium Report of the Memorial Hospital. Paul B. Hoeber, New York, 1923.
25. Hazen, H. H. Roentgen-ray treatment of cutaneous cancer. *Southern M. J.*, 1919, xii, 87.
26. Clark, W. L. Cancer. *J. Am. M. Ass.*, 1918, lxxi, 1365.
27. Pfahler, G. E. Cancer of the lip. *Arch. Dermat. & Syph.*, 1922, vi, 428–433.
28. Wyeth, G. A. (Discussion of paper by E. S. Lain on "Treatment of Cancer of the Lip By Radiation.") *Arch. Dermat. & Syph.*, 1922, vi, 443.
29. Stevens, J. Thompson. Statistics and technique in the treatment of superficial malignancy with radium, roentgen rays and electrothermic coagulation. Am. J. Roentgenol. (etc.), 1924, xi, 241–246.
30. Sherwell, S. Further observations on the technique of an efficient procedure for the removal and cure of superficial malignant growths. *J. Cutan. Dis. incl. Syph., N. Y.*, 1910, xxviii, 487–496.
31. Kingery, L. B. Saturation in roentgen therapy; its estimation and maintenance, preliminary report. *Arch. Dermat. & Syph.*, 1920, i, 423.
32. Keith, D. Y. Mixed radiation in malignant disease. Am. J. Roentgenol. (etc.), 1924, xii, 53–57.
33. Bisserie. *Arch. Roent. Ray*, 1906, xi, 142.
34. Boggs, R. H. Treatment of epithelioma by radium. *Am. J. M. Sc., Phila.*, 1919, clviii, 87.
35. Broders, A. C. Squamous-cell epithelioma of the lip. *J. Am. M. Ass.*, 1920, lxxiv, 656.
36. Seitz, L., and Wintz, H. Grundsätze der Röntgenbestrahlung des Gebärmutterkrebses und des Karzinoms im Allgemeinen. Die Karzinomdosis. *München. med. Wchnschr.*, 1918, lxv, 89–92.
37. Wood, F. C., and Prime, F. Lethal dose of roentgen rays for cancer cells. *J. Am. M. Ass.*, 1920, lxxiv, 308.
38. Kimura, N. Effects of *x*-ray irradiation on living carcinoma and sarcoma cells in tissue cultures in vitro. *J. Cancer Research*, 1919, iv, 95.

39. Wedd, B. H., and Russ, S. The effect of Röntgen and radium radiations upon the vitality of the cells of mouse carcinoma. *J. Path. & Bacteriol.*, 1912–13, xvii, 1–11.
40. Opitz, E. Principles of radiotherapy of carcinomata especially of uterine and mammary carcinomata. Am. J. Roentgenol. (etc.), 1923, x, 312–319.
41. Hesse, E. Über Verimpfung eines roentgenbestrahlten Karzinoms beim Menschen. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1923, xxx, 101.
42. Perthes, J. Zur Biologie und Klinik der Röntgentherapie der chirurgischen Krebse. *Strahlentherapie*, 1923, xv, 695–714.
43. Loeb, L. Effects of roentgen rays and radioactive substances on living cells and tissues. *J. Cancer Research*, 1922, vii, 229–282.
44. Murphy, James B., and Morton, John J. The lymphocyte in natural and induced resistance to transplanted cancer. II. Studies in lymphoid activity. *J. Exper. M.*, 1915, xxii, 204–211; the effect of roentgen rays on the rate of growth of spontaneous tumors in mice. *Ibid.*, 800–803.
Murphy, J. B., and Ellis, A. W. M. Experiments on the rôle of lymphoid tissue in the resistance to experimental tuberculosis in mice. *J. Exper. M.*, 1914, xx, 397–403; 1914, xix, 513.
Morton, John J. Rapid method for the diagnosis of renal tuberculosis by the use of the *x*-rayed guinea pig. *J. Exper. M.*, 1916, xxiv, 419–427.
Taylor, H. D., Witherbee, W. D., and Murphy, J. B. Studies on *x*-ray effects. I. Destructive action on blood cells. *J. Exper. M.*, 1919, xxix, 53–73.
Nakahara, Waro. Studies on *x*-ray effects. III. Changes in the lymphoid organs after small doses of *x*-rays. *J. Exper. M.*, 1919, xxix, 83–87.
Hill, Elsa, Morton, John J., and Witherbee, W. D. Studies on *x*-ray effects. IV. Direct action of *x*-rays on transplantable cancers of mice. *J. Exper. M.*, 1919, xxix, 89–96.
Murphy, J. B., and Sturm, Ernest. The lymphocytes in natural and induced resistance to transplanted cancer. IV. Effect of dry heat on resistance to transplanted cancer in mice. *J. Exper. M.*, 1919, xxix, 25–30.
Murphy, J. B., and Sturm, Ernest. Effect of stimulation of the lymphocytes on the rate of growth of spontaneous tumors in mice. *J. Exper. M.*, 1919, xxix, 31–34.
Murphy, J. B. Heteroplastic tissue grafting effected through roentgen-ray lymphoid destruction. *J. Am. M. Ass.*, 1914, lxii, 1459.
45. Murphy, J. B., Hussey, R. G., Nakahara, Waro and Sturm, E. Studies on *x*-ray effects. VI. Effect of the cellular reaction induced by *x*-rays on cancer grafts. *J. Exper. M.*, 1921, xxxiii, 299–313.
Liu, J. H., Sturm, E., and Murphy, J. B. Studies on *x*-ray effects. XI. The fate of cancer grafts implanted in subcutaneous tissue previously exposed to *x*-rays. *J. Exper. M.*, 1922, xxxv, 487–492.
Nakahara, Waro. Studies on *x*-ray effects. XIII. Histological study on the fate of cancer grafts inoculated into an *x*-rayed area. *J. Exper. M.*, 1923, xxxviii, 309–314.
Murphy, J. B., Maisin, J., and Sturm, Ernest. Local resistance to spontaneous mouse cancer induced by *x*-rays. *J. Exper. M.*, 1923, xxxviii, 645–653.
Murphy, J. B. Experimental studies in roentgen-ray effects. Am. J. Roentgenol. (etc.), 1924, xi, 544–546.
46. Ewing, James. Mode of radiation upon carcinoma. Am. J. Roentgenol., 1922, ix, 331–336.
47. Joly. *Proc. Royal Soc. Lond.*, Series B, 1914–15, lxxxviii, 262.
48. Barclay. Quoted by Loeb.
49. Friedrich, W., and Behne, K. Ueber die Bedeutung der Bestrahlungstechnik für die Starke der biologischen Wirkung der Röntgenstrahlen auf das Uteruskarzinom. *Strahlentherapie*, 1920, xi, 35–43.
50. Bragg and Bragg. *Proc. Royal Soc. Lond.*, 1913, Series A, lxxxviii, 428.
51. Keetman, B., and Mayer, M. Gesichtspunkte für die Mesothoriumtherapie. *Strahlentherapie*, 1913, iii, 745–758.
52. Redfield, A. C., and Bright, Elizabeth, M. The relative physiological effects of B and Y-rays upon the egg of *Nereis*. *J. Gen. Physiol., Balt.*, 1919–20, ii, 25–29. The relative physiological effects of rays of different velocities. *J. Gen. Physiol., Balt.*, 1919–20, ii, 31–47.
53. Gager, C. S. The probability of a radiotropic response. *Proc. Am. Soc. Biol. Chemists, Balt.* 1908, iv, xliii.
54. Koernike. Quoted by Loeb.
55. Lazarus-Barlow. Quoted by Loeb.
56. Richards, A. The effect of *x*-rays on the action of certain enzymes. *Am. J. Physiol., Balt.*, 1914, xxxv, 224–238.
57. Packard, Charles. The effect of radium emanation on the rate of cell division. *J. Exper. Zool.*, 1916, xxi, 199. (Abs. in Am. J. Roentgenol., 1916, iii, 556.)
58. Roth, S. C., and Morton, J. J. The immediate effect of radium and *x*-rays on enzyme action. Am. J. Roentgenol. (etc.), 1923, x, 407–408.
59. Parkhurst, H. J. Tissue reaction in malignant epitheliomas of skin. *Arch. Dermat. & Syph.*, 1922, vi, 401–412.
60. Kok, F. Action of roentgen rays on cancer. *Deutsche med. Wchnschr.*, 1924, l, 298.
61. Millet, J. A. P., and Müller, T. Phases of radium action. *J. Cancer Research*, 1918, iii, 127.
62. Mottram, J. C., and Russ, S. Observations and experiments on the susceptibility and immunity of rats towards Jensen's rat sarcoma. *Proc. Royal Soc. Lond.*, Series B, 1917–18, xc, 1–33.
63. Prime, F. Lymphocytes and cancer immunity *J. Cancer Research*, 1920, v, 105.
64. Sittenfield, M. J. Significance of lymphocytes. *J. Cancer Research*, 1917, ii, 151.

FINAL RESULTS IN THE TREATMENT OF CARCINOMA OF THE UTERINE CERVIX AT "RADIUMHEMMET" STOCKHOLM*

BY JAMES HEYMAN, M.D.

Lecturer at the Royal Caroline Institute

STOCKHOLM, SWEDEN

MY paper deals with the results in radium treatment of carcinoma of the uterine cervix. Cases of carcinoma of the uterine body, of recurrences after radical operations, and prophylactically post-treated cases are not included.

I have limited my account to the period between 1914 and 1921 inclusive. The results of the treatment at Radiumhemmet in Stockholm during 1910–1913, when Forssell was evolving the technique, are not presented here. The treatment in these years underwent great changes in technique, and was widely different from the one we have employed since that time. The cases of 1922 and 1923 have as yet been under observation too short a time to be worth publishing.

I shall dwell only on the terminal results of our method of treatment.

The palliative effect of radium treatment is now generally recognized to be better than from any other method of treatment.

The question whether different types of cancer differ in their susceptibility to radiation I shall not discuss here. We have, like most authors, the general impression that the squamous-cell carcinoma, especially the mature one, is prognostically more favorable than the columnar-celled.

Only a few words about the technique of treatment used at "Radiumhemmet."

At the end of 1913 and beginning of 1914 Forssell gradually elaborated the technique, which we have followed in the main ever since; a smaller number (usually three) of intensive treatments (each of about 105–112 mgm. radium element) with strong filtration (equivalent to 3–4 mm. of lead), given in the course of three to four weeks. All our cases are treated with radium. Only rarely do we now resort to roentgen treatment in carcinoma of the cervix in conjunction with radium treatment. We have abandoned the combined roentgen and radium treatment, since we found that the results were not better but rather worse than with radium treatment alone.

My report comprises all cases, 505 in number, of primarily radium treated carcinoma of the cervix that have been treated at "Radiumhemmet" within the above mentioned eight-year period.

Only exceptionally in the first five years embraced by this report did we treat any but inoperable cases and technically operable cases in which a radical operation was considered contraindicated for some reason or other (cardiac or pulmonary disease, poor general condition, etc.).

The chief reason for this procedure was that Forssell on repeated occasions during this period stated that until further experience had been gained, cases suitable for treatment by hysterectomy should be operated upon. He considered that one should first of all obtain sufficient experience in the radium treatment in those locally concentrated cases in which an operation was contraindicated, and only after this was the radium treatment to be extended to the operable cases if the results pointed in that direction.

During 1919–1920 "Radiumhemmet" was able to present a report on its first results after a period of observation of four to five years. In these papers I gave an account of the course of 66 cases treated in 1914 and 1915, 33.3 per cent of whom were still alive four to five years after the commencement of treatment. Our results were considered such a strong argument in favor of radium treatment that surgeons and gynecolgists of Sweden began more and more to restrict the operative therapy.

* Read at the Twenty-fifth Annual Meeting, AMERICAN ROENTGEN RAY SOCIETY, Swampscott, Mass., Sept. 3–6, 1924.

In about 1920 several of our leading gynecologists gave up operating on carcinoma of the cervix uteri. In the following years we received, as a consequence of this, an ever-increasing number of operable cases. The inoperable cases are, however, still predominating, and as late as 1921 the inoperable plus the borderline cases constituted 63.5 per cent, while 36.5 per cent were operable.

The proportion is illustrated by the first table, showing the number of inoperable plus borderline cases of the different years:

TABLE I

1914	inoperable plus borderline cases 88.5 per cent
1915	inoperable plus borderline cases 97.5 per cent
1916	inoperable plus borderline cases 93.6 per cent
1917	inoperable plus borderline cases 88.9 per cent
1918	inoperable plus borderline cases 87.8 per cent
1919	inoperable plus borderline cases 76.3 per cent
1920	inoperable plus borderline cases 68.1 per cent
1921	inoperable plus borderline cases 63.5 per cent

You will find the inoperable cases averaging 91.3 per cent in the first 5-year period, the figures then dropping from 76.3 per cent in 1919 to 63.5 per cent in 1921.

As a matter of fact, the number of inoperable cases has been even greater than is shown by Table 1. At such times when the number of patients applying to the hospital for treatment has been great it has been impossible for us, from considerations of space, to receive them all. At times we have had to turn away patients, and then, of course, the most advanced cases first. The total number of cases that have applied but not been admitted for treatment is 41, i.e., 7.5 per cent of all those applying. All patients received for treatment are included in this report, whether the treatment has been pursued or not. Patients who have received palliative treatment are also included. The classification of the cases into operable and inoperable has been followed according to common principles. Such cases, in which the operation has been technically possible but contraindicated on account of some complication, have been included in those operable.

A thorough and minutely organized control of the patients has made it possible for us not to lose sight of a single patient during all these years. All the patients from 1914–1921 have been examined five, four and three years respectively, after the commencement of their treatment.

TABLE II

THE DISTRIBUTION OF THE CASES

Year	Cases	Per Cent Operable
1914	26	11.5
1915	40	2.5
1916	47	6.4
1917	63	11.1
1918	41	12.2
1919	76	23.7
1920	95	31.9
1921	115	36.5

The borderline cases are not included among those operable. They constituted 7.3 per cent of the total number.

The ages of our 505 cases were:

TABLE III

	Cases	Per Cent
40 years or less	96	19.01
41–45 years	70	13.86
46–55	171	33.86
56–55	132	26.14
above 65 years	36	6.13

In round numbers one-third of the cases were 45 years old or less, one-third were from 46 to 55 years, and one-third were more than 56.

When I employ the expressions symptom free or clinically healed in the following I mean that the patients are free from subjective symptoms and able to work, and that cancer could not be proved on examination. It is only natural that at the moment of preparing statistics one is sometimes doubtful as to how a particular case is to be entered. Such a hesitancy is most often caused by the condition found on vaginal and bimanual examination being difficult to interpret. The subsequent course alone is in that case able to clear the matter up. In spite of all experience, every care in the examination and the greatest caution in the interpretation of the case, mistakes can be made in either direction. In those doubtful cases which I have included in my statistics as symptom-free the changes have been but little marked, and the condition has been stationary for at least a year. All the patients

that have died have been counted as dead of cancer.

TABLE IV

RESULTS. SYMPTOM-FREE FIVE YEARS AFTER THE COMMENCEMENT OF THE TREATMENT

			Per Cent
Of 26 cases	1914	7	26.9
Of 40 cases	1915	13	32.5
Of 47 cases	1916	4	8.5
Of 63 cases	1917	9	14.3
Of 41 cases	1918	11	26.8

Of a total of 217 cases, 44 (20.29 per cent) were symptom-free five years after the commencement of treatment.

The figure 20.29 per cent, is, however, hardly a correct representation of the results which can really be obtained by our method. As I shall explain, the average figure ought to be raised a little. From Table v it will be seen that the results of the years 1916 and 1917 have to an essential degree been so much worse than those of the years 1914, 1915 and 1918 that the total result is materially affected. One can quite well imagine that this might be due to such inevitable changes as are well known from the statistics of operations for instance. However, after having studied closely all factors that might have caused the poor results in 1916 and 1917 it seems to me more probable that the main cause has been that we did not carry out the treatment in accordance with our principles.

Two circumstances are to blame for this. The one was associated with the publication of our first paper, which, in view of our successful results, caused the patients applying for treatment to be far in excess of the number we were able to deal with, because of our limited supply of radium. The other was the great enthusiasm to which I plead guilty when Forssell, from 1916 on, left the gynecological treatment entirely to me.

During these years I admitted too many patients. They had to wait a long time before I could treat them, the treatment became irregular, and our supply of radium had to be divided among so many that several patients received too small a dose. In this way in 1916 and 1917 31.9 per cent, and 20.6 per cent, respectively were treated with too small doses (less than 3000 mgm. element hours in the vagina), whereas the corresponding figure for 1918–1920 was 4.1 per cent.

To the account of my enthusiasm I must also put down the repeated removal of tissue during the treatment in 1916. Profuse hemorrhage was the result in some cases, and here the damage is obvious. In other cases an impaired tendency to heal or a dissemination of the tumor may have been the cause of the unhappy issue. In short, of the 14 patients in whom tissue for study was taken three times or more, none are alive, and only one lived more than a year and a half.

Regarding this, I think that the cause of the worse results in 1916 and 1917 must be sought in shortcomings of the treatment, and thus in circumstances, which can be avoided.

Table v will show you that the poor results in 1916 and 1917 have not been repeated in the subsequent years. In this table I have worked out the number of symptom-free cases one year, one and a half years, two, three and four years after the commencement of the treatment. From these calculations it appears that the number of symptom-free cases for 1914, 1915 and 1918 were:

TABLE V

After 1	year	between 37.5 and 46.3 per cent
After 1.5	years	between 34.6 and 41.5 per cent
After 2	years	between 34.6 and 36.6 per cent
After 3	years	between 30.8 and 32.5 per cent
After 4	years	between 26.9 and 32.5 per cent
After 5	years	between 26.8 and 32.5 per cent

The corresponding figures for the three last years embraced by this report are:

TABLE VI

1921, after 2 years, 39.1 per cent
1920, after 3 years, 30.9 per cent
1919, after 4 years, 27.6 per cent

We find thus that the result of these last years is at present on a par with the good results observed at a corresponding time in 1914, 1915 and 1918. And the result, judged after five years, will probably be similar, though surprises, in consideration of the small yearly number of cases treated, might of course occur.

For this reason we may certainly feel warranted in considering that the average figures of the symptom-free result obtained by our method of treatment, judged after a

period of five years ought rather to be fixed somewhere between 26 and 30 per cent.

In order to render it possible for anybody who desires to draw a comparison between our radiologically treated cases and those operated on, I here state the course of our operable and borderline cases together.

During 1914 to 1918 inclusive we treated altogether 36 of these cases (19 operable cases, 17 borderline cases). Of these 14 (40.5 per cent) were still symptom-free after five years. Here, too, the average result is unfavorably influenced by the poor results of 1916 and 1917.

TABLE VII

In 1914–1918, 36 cases were treated; 14 (40.5 per cent) were still symptom-free after 5 years
In 1919, 23 cases were treated; 11 (47.8 per cent) were still symptom-free after 4 years
In 1920, 40 cases were treated; 24 (60.0 per cent) were still symptom-free after 3 years
In 1921, 48 cases were treated; 28 (58.3 per cent) were still symptom-free after 2 years.

Our average result in the radium treatment of operable and borderline cases, which is 40.5 per cent of the total number of these cases, is at least on a par with the results obtained by surgical interference.

In comparing the results of cases which have been operated upon with those radiologically treated but nevertheless operable, one ought to bear in mind:

That the result with the radium treatment is obtained with a very small primary mortality. We have in total lost 6 cases of 505, that is 1.9 per cent, through peritonitis or sepsis.

That in a considerable number of inoperable cases (1914–1918, 30 cases out of 181 or 16.6 per cent) clinical healing has been secured which has persisted for at least five years.

That of the remaining inoperable cases (technically operable cases are not included) nearly 20 per cent on an average, some years more than 25 per cent, have still been symptom-free three years after the commencement of treatment.

That in the majority of treated cases, even though a complete absence of symptoms has not been secured, a more or less lasting improvement has been obtained which has been of great importance to the patient.

And that the radiological method of treatment probably still has great possibilities of further development.

But, on the other hand, it must be emphasized that to ensure a good result the radium treatment, as well as the surgical treatment, requires a strict planning, a technique carefully carried out, and a fair share of experience. In the hands of the inexperienced it is attended with great risks without affording any chances of obtaining results comparable with those that can be obtained by the operative treatment.

VALUE OF RADIUM AND ROENTGEN RADIATION IN THE TREATMENT OF BENIGN UTERINE HEMORRHAGE*

BY HARRY E. BUNDY, M.D.

CHICAGO, ILLINOIS

BLEEDING of benign origin from the genito-urinary tract in women may be divided into four classes as regards treatment with radium and roentgen radiation. These are fibroids, essential menorrhagia or hemorrhagic metropathy, bleeding following inflammatory adnexal disease, and lastly the pernicious bleeding during gestation. The treatment of these conditions is well known to all radiologists and the results obtained are quite uniform where the proper selection of cases is made and the proper dosage of either radium or roentgen rays is applied.

Fibroids, generally speaking, are a surgical disease; however, under some conditions they may be treated with good results by means of the gamma rays. Small fibroids, the size of a grapefruit, should be treated with radium; while those the size of a first trimester pregnancy respond better to roentgen rays or a combination of radium and roentgen rays. Myomata larger than a first trimester pregnancy, should not be treated with radium or roentgen rays if surgical interference is possible. Diabetes, heart and kidney lesions, hypertension, etc., at times prevent surgical procedures from being used, and it is this class that offers a good field for radiology. It must be remembered that a full dose of radium applied to the endometrium, or roentgen rays to the pelvis, will usually create a menopause and preclude any further possibility of pregnancy in those who might otherwise desire it. However, as these cases are often sterile, if the fibroid is of any size, it is readily seen that the question of future pregnancy in large tumors will not interfere with the desired treatment. Rapidly growing fibroids should be dealt with surgically, as often degeneration is taking place with the possibility of malignant change which offers better opportunity for total eradication by means of the knife. In young women we have been using small doses of radium, 300 to 600 milligram element hours, repeating if necessary in order to preserve the menstrual function.

The second class, or essential menorrhagias, are those cases where bleeding occurs without demonstrable pathology. In this type radium is of great value, giving excellent results in our series and others reported in the literature. It has been our policy to do a diagnostic curettage whenever radium has been applied intrauterine with an excision of suspicious tissue when indicated. In this manner we endeavor to discover early carcinoma, polyps, etc. All tissue removed is examined microscopically.

Regarding the bleeding from adnexal disease, and that occurring during gestation, we have found that these cases often are intractable to ordinary forms of treatment, and for the past two years we have used roentgen radiation over the spleen when other measures have failed. The results are good although not every case responds. We feel, however, that this method should be borne in mind and used as a last resort.

Foster and Whipple report a rise in fibrinogen values after irradiation of intestinal and thoracic areas and believe that any cell injury in the body with or without an inflammatory reaction causes a prompt rise in fibrinogen values. Stephan has shown that roentgen radiation over the spleen causes this organ to form a coagulating ferment, and used this form of treatment to hasten coagulation in cases of intractable hemorrhage. Nurenberger also reports good results in cases of hemorrhage due to tumors of the adnexa and hemorrhage of ovarian origin.

We have treated 68 myomata in our clinic with radium or roentgen radiation, and of these 2 were found to have undergone sarcomatous degeneration within six months after treatment and were operated upon. One submucous fibroid

* Read at the Ninth Annual Meeting, AMERICAN RADIUM SOCIETY, Chicago, Ill., June 9, 1924.

was treated surgically; but in the remainder amenorrhea or oligomenorrhea resulted. The size of the fibroid was generally diminished following treatment, although in a few cases this was not remarkable.

In our cases of hemorrhagic metropathy we treated 152 cases. Of these one developed carcinoma of the fundus later or was overlooked at the time of treatment in spite of the fact that the tissue removed by a curettage showed no evidence of malignancy. There has been one fatality, the patient developing a peritonitis following treatment. One case resisted treatment and hysterectomy showed a small polyp in the fundus. It was necessary to re-treat a few cases, 10 cases being radiated twice and 4 cases three times.

As to the treatment by roentgen radiation over the spleen we have adopted this method in cases of bleeding following inflammatory adnexal disease and the pernicious bleeding of gestation. We have treated 33 cases with good results in all but 4. It is interesting to note that in all 5 cases of bleeding during gestation the results were perfect. The dose used is 15 per cent delivered to the spleen, repeated in forty-eight hours if the hemorrhage persists, giving at this time a two-thirds erythema skin dose.

We have adopted the following rules for treatment of benign bleeding of the genitourinary tract in women:

Whenever radium is used intrauterine, a thorough diagnostic curettage is done and the tissue examined microscopically.

Pelvic infections contraindicate the use of radium.

Small doses are used whenever possible in order to preserve the menstrual cycle.

The radium capsule is placed in the fundus, not in the internal os, in order not to destroy the mucous membrane with resulting atresia followed by pyometra, hydrometra, etc.

Uterine bleeding in women at or past the menopause is treated as though malignant.

In small fibroids myomectomy is preferable to hysterectomy. Large fibroids or those increasing in size rapidly, as well as adenomyomata, are considered to be surgical.

Where radium is used in the uterus without cessation in the bleeding, we do not re-treat until three to six months have elapsed.

The dose of radium varies from 300 milligram element hours in young women to 1200 milligram element hours in older women, which is sufficient to stop the excessive bleeding.

The only symptom indicating the use of radium or roentgen radiation in or over the uterus in benign conditions is hemorrhage.

Radiation over the spleen is used when other measures for the control of hemorrhage have failed.

THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

Editor: ARTHUR C. CHRISTIE, M.D.

Editorial Board: JAMES T. CASE, M.D. H. K. PANCOAST, M.D. WILLIAM DUANE, PH.D.

Advisory Board for Pathology: JAMES EWING, M.D. EUGENE OPIE, M.D. A. S. WARTHIN, M.D.

Collaborating Editors: The Officers and Committee Members of the Societies of which this JOURNAL is the official organ, whose names appear on this page, are considered collaborating editors of this JOURNAL. *Foreign Collaborators:* A. BECLERE, M.D., PARIS. GÖSTA FORSSELL, M.D., STOCKHOLM. G. F. HAENISCH, M.D., HAMBURG. ROBERT KNOX, M.D., LONDON. R. LEDOUX-LEBARD, M.D., PARIS.

Publishers: PAUL B. HOEBER, INC., NEW YORK

Issued Monthly. Subscription $10.00 per year, $11.00 in Canada and $12.00 in foreign countries. Advertising rates submitted on application. Editorial office, 1909 Massachusetts Ave., N.W., Washington, D.C. Office of publication, 67-69 East 59th Street, New York

Information of interest to all readers will be found on page iii. Lists of officers of The American Roentgen Ray Society and The American Radium Society will be found below.

Officers and Standing Committees

THE AMERICAN ROENTGEN RAY SOCIETY

President: GEO. W. HOLMES, Massachusetts Gen. Hosp., Boston; *President-Elect:* T. A. GROOVER, 1909 Massachusetts Ave., N. W., Washington, D. C.; *First Vice-President:* JOSEPH STEINER, N. Y. C.; *Second Vice-President:* J. T. MURPHY, Toledo, O.; *Secretary:* CHAS. L. MARTIN, 701 Medical Arts Bldg., Dallas, Tex.; *Treasurer:* WM. A. EVANS, 10 Petersboro St., Detroit; *Librarian and Historian:* H. W. DACHTLER, 224 Michigan St., Toledo, O.

Executive Council: A. H. PIRIE, Chairman, Montreal, Can., H. M. IMBODEN, N. Y. C., E. H. SKINNER, Kansas City, Mo., GEO. W. HOLMES, Boston, T. A. GROOVER, Washington, D. C., A. C. CHRISTIE, Washington, D. C., CHAS. L. MARTIN, Dallas, Tex., WM. A. EVANS, Detroit, RALPH LEONARD, Boston, Mass., B. R. KIRKLIN, Munice, Ind., H. B. THOMPSON, Seattle, Wash.

Committee on Laws and Public Policy: BUNDY ALLEN, Chairman, Iowa City, Ia., B. R. KIRKLIN, Munice, Ind., THOS. BURCHAM, Des Moines, Ia.

Safety Committee: H. K. PANCOAST, Chairman, Philadelphia, Pa., P. M. HICKEY, Ann Arbor, Mich., J. T. MURPHY, Toledo, O., W. D. COOLIDGE, Schenectady, N. Y., WM. DUANE, Boston, B. H. NICHOLS, Cleveland, O.

Leonard Prize Committee: G. W. GRIER, Chairman, Pittsburgh, Pa., F. M. LAW, N. Y. C., G. E. RICHARDS, Toronto, Can.

Publication Committee: H. M. IMBODEN, Chairman, N. Y. C., WM. A. EVANS, Detroit, E. H. SKINNER, Kansas City, Mo.

Member, National Research Council: P. M. HICKEY.

American Board of Registry of Radiological Technicians: E. S. BLAINE, Chicago.

Editor: A. C. CHRISTIE, 1909 Massachusetts Ave., N. W., Washington, D. C.

Editorial Board: JAMES T. CASE, H. K. PANCOAST, WM. DUANE.

Associate Editors: CHAS. EASTMOND, D. Y. KEITH, R. A. PAYNE.

Advisory Board for Pathology: JAMES EWING, EUGENE OPIE, A. S. WARTHIN.

Publishers: PAUL B. HOEBER, Inc., 67-69 E. 59th St., N. Y. C.

Twenty-sixth Annual Meeting: At Washington, D. C. September 22-25, 1925.

SECTIONS OF THE AMERICAN ROENTGEN RAY SOCIETY

EASTERN SECTION: RALPH LEONARD, Chairman, Boston, Mass., HOWARD E. ASHBURY, Vice-Chairman, Baltimore, Md., F. M. HODGES, Secretary, Richmond, Va.

Seventh Annual Meeting: To be announced.

CENTRAL SECTION: B. R. KIRKLIN, Chairman, Munice, Ind., J. T. MURPHY, First Vice-Chairman, Toledo, O., GEO. F. THOMAS, Second Vice-Chairman, Cleveland, O., WM. A. EVANS, Secretary, Detroit.

Sixth Annual Meeting: At Detroit, February 19, 20, and 21, 1925.

WESTERN SECTION: H. B. THOMPSON, Chairman, Seattle, Wash., IRVING INGBER, Secretary, San Francisco.

THE AMERICAN RADIUM SOCIETY

President: WM. S. NEWCOMET, 3501 Baring St., Philadelphia; *President-Elect:* DOUGLAS QUICK, N. Y. C.; *First Vice-President:* ALBERT SOILAND, Los Angeles; *Second Vice-President:* E. C. SAMUEL, New Orleans; *Secretary:* E. C. ERNST, St. Louis; *Treasurer:* R. E. LOUCKS, Detroit.

Executive Committee: GEO. E. PFAHLER, Chairman, Philadelphia, R. E. LOUCKS, Detroit, JAMES T. CASE, Battle Creek, Mich.

Program Committee: DOUGLAS QUICK, Chairman, N. Y. C., LEDA J. STACY, Rochester, Minn., H. W. VAN ALLEN, Springfield, Mass.

Membership Committee: SANFORD WITHERS, Chairman, Denver, Colo., ISAAC GERBER, Providence, R. I., B. R. KIRKENDALL, Columbus, O.

Publication Committee: H. K. PANCOAST, Chairman, Philadelphia, G. FAILLA, N. Y. C., E. C. ERNST, St. Louis.

Standardization Committee: WM. DUANE, Chairman, Boston, HENRY SCHMITZ, Chicago, A. WEATHERWAX, Philadelphia.

EDITORIALS

PROGRESS IN THE ROENTGENOLOGIC EXAMINATION OF THE GALL-BLADDER

THE history of the roentgenologic diagnosis of cholecystic disease has been marked by an orderly but slow succession of events.

For many years after 1900, when Beck discovered the shadow of a gallstone, all effort was confined to the detection of such shadows. Soon it was learned that only stones containing lime were demonstrable, and the less the amount of lime the greater was the difficulty of finding them with the roentgen ray. Only a small proportion of stones could be depicted, for apparatus was imperfect, long exposures were required, and definition was poor. This condition of affairs continued with little change for more than a decade.

Meantime, apparatus had been slowly improved, helpful accessories had been brought out, and skill was increasing. Greater activity was now directed to the technical minutiae of roentgenography, and the roentgenograms were studied more intensively. An increase of diagnostic efficiency ensued. Less lime was necessary to make stones demonstrable. Even those with a thin layer of calcium on their surface only, were sometimes discoverable. Inspection of the plates or films became a delicate procedure. Subtle judgment was needed to distinguish between faint, ill-defined shadows of stones and other vague shadows rather constantly present in the right upper quadrant. Controversies, sometimes heated but Pickwickian, were indulged in as to the length to which this refined interpretation could safely be carried, the conscious or unconscious influence of the clinical history, and the practical value of the examination.

With the accepted supertechnique and superinterpretation it became possible occasionally to reveal the shadow of the gall-bladder itself, although identification of the shadow often depended too greatly on the patience, skill and courage of the examiner. It was assumed that any gall-bladder which cast a shadow was diseased, and simple roentgenography received new impetus. However, many markedly diseased gall-bladders were still invisible. Finally, it was established that under favorable circumstances a normal gall-bladder could be depicted on the film. While a very large or very dense shadow of the gall-bladder could reasonably be regarded as indicating disease, it was hazardous to attach diagnostic significance to a shadow of normal size and faint density.

Attention was then turned to the indirect manifestations of cholecystic disease, namely, deformity of the duodenum or hepatic flexure by adhesions, drawing of the pylorus upward and to the right, gastrospasm, and indentation of the duodenal bulb or gastric antrum by the gall-bladder. From observation it became fairly certain that while these secondary signs were discoverable in some cases of disease of the gall-bladder, they were also seen in cases in which no disease of the gall-bladder could be found.

Thus, at the beginning of 1924 the survey was disappointing. There were three bases for diagnosis; shadows of gallstones, a shadow of the gall-bladder, and secondary manifestations in the stomach or bowel. It was the general experience that not more than half the stones cast shadows. Other phenomena were inconstant and unreliable. To elicit these bases entailed exacting technique and equally exacting interpretation. It is not surprising, therefore, that the results varied widely, and that few examiners could claim a high percentage of correct diagnoses.

Most disconcerting of all was the fact that pathologists had found disease of the gall-bladder to exist in virtually all persons beyond the age of thirty. In many instances

the abnormality could be revealed only by the microscope, but clinical and surgical experience had shown that minimal changes of this sort were sometimes capable of producing annoying symptoms. That the roentgen ray could demonstrate purely microscopic lesions directly was patently impossible. Moreover, doubt was cast on the statistics of roentgenologic diagnosis, since an affirmative diagnosis on any basis could be confirmed by cholecystectomy and microscopic examination.

So discouraging was the outlook that many roentgenologists contented themselves with the demonstration of gallstones when the shadows were definite, and with the roentgenologic exclusion of gastrointestinal and renal disease. Regardless of what a few roentgenologists might be able to do, the roentgenologic diagnosis was not generally held in high esteem. Here the accomplishments of the roentgen ray suffered by comparison with its advances in other directions. Yet progress had been made. Nothing could be erased from the record without some loss. While the gain was small, it was a gain. Most importantly, the goal had been kept in view.

An attempt to name those who contributed substantially to this slow but advancing history means the inevitable omission of some one who gave conspicuous service. At the moment it is most easy to recall Pfahler, Cole, Case, George, Roberts, and Kirklin of this country, Knox, of England, and the late Neil Macleod, in Shanghai. Distinction among them is perhaps futile also, but no small share of credit may be awarded to George, whose energetic persistence in this field maintained interest and hope. His book, written with Leonard, was a strong stimulus to more strenuous endeavor and greater excellence.

Meanwhile, certain pharmacologic studies had been conducted which were destined later to influence the roentgenologic diagnosis of cholecystic disease, although such a relation was not apparent at the time. In 1909 Abel and Rowntree, experimenting with phthaleins and their derivatives, proved that phenoltetrachlorphthalein, when given subcutaneously, was excreted in the bile only. Subsequently, Rowntree introduced this into clinical medicine as a test for hepatic function. Another pertinent step was taken in 1923, when Rowntree and his associates demonstrated that roentgenography of the urinary tract was feasible during the excretion of sodium iodid, which had been administered intravenously or by mouth.

Early last year Graham and Cole reported that the sodium salt of tetrabromphenolphthalein, when given intravenously, was excreted in the bile and being opaque to roentgen rays, produced an unmistakable shadow of the gall-bladder. This discovery promised a new epoch in the diagnosis. Its fundamental principle, that of visualizing a hollow viscus by filling it with opaque materials, had been well tested in the examination of the digestive and urinary tracts. The possibilities of the new method of examining the gall-bladder aroused keen interest. For the first time an opportunity was offered to make roentgenologic diagnoses consistently on a purely objective basis.

During the last few months several hundred patients have been examined by Graham and others, and the results seem to have fulfilled expectations. Gallstones which could not be revealed by simple roentgenography have usually either produced a mottling of the shadow, or wholly excluded the dye from the gall-bladder. A very high percentage of all diseased gall-bladders have given abnormal responses to the test. Thus far it would appear that the most common and most reliable sign of disease is failure of the gall-bladder to fill with the dye. Minor eccentricities of filling and emptying probably also have significance which will be learned in time. By revealing disordered function these lesser signs offer the hope of disclosing the gall-bladder with minute pathologic changes, which has presented the most difficult diagnostic problem.

Notwithstanding the bright prospect, many obstacles are yet to be overcome. The dye in present use has certain disadvantages. Most serious of these is its toxicity. The required dose has too scant a margin of safety. Reactions, sometimes severe, occur too often. Contraindications

to the use of the dye are numerous, thus impairing its practical efficiency. Intravenous administration of any drug is not a trivial matter, and is a handicap to routine employment of this dye. Because of these objectionable features, a few examiners have suspended use of the method.

However, the drawbacks are surely not insurmountable. Given a non-toxic agent, and, if possible, one which does not require intravenous administration, the roentgenologic diagnosis of cholecystic disease should become practicable and highly dependable as a routine. A millenium of diagnostic simplicity and perfection is not to be expected. As diagnosis approaches accuracy it becomes increasingly complex and difficult, for the law of diminishing returns operates here as elsewhere.

No one may pretend to foresee the ultimate outcome, but cholecystography now looms large on the horizon.

RUSSELL D. CARMAN.

Subscribers to THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY *visiting New York City, are invited to make the office of* THE JOURNAL *(69 East 59th Street, New York) their headquarters. Mail, packages or bundles may be addressed in our care. Hotel reservations will gladly be made for those advising us in advance; kindly notify us in detail as to requirements and prices. List of operations in New York hospitals on file in our office daily.*

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this column solicited promptly after the events to which they refer.

MEETING OF THE EASTERN SECTION AMERICAN ROENTGEN RAY SOCIETY, ATLANTIC CITY JANUARY 22–24, 1925

THE Eastern Section met this year as usual at Chalfonte-Haddon Hall with an attendance of over two hundred. The sessions were presided over by Dr. Charles Eastmond, president of the Section, with Dr. Fred M. Hodges as secretary.

At the opening session Dr. Hugh Young gave an unusually interesting and instructive address on "The Relation of Roentgenology to Urology, with Demonstration of Methods," during which he showed how the spectacular advances in urology during the past decade have been largely dependent upon the assistance of the roentgen ray. Dr. Young exhibited the table devised by him for combined urologic and roentgenologic examination. Such a table, with its admirable facilities for urologic examination and instrumentation and its arrangements for roentgenologic examination in any desired position, with its movable Potter-Bucky diaphragm, must become a standard part of the equipment of everyone doing roentgenology of the urinary tract. Many lantern slides of interesting pathologic conditions were shown by Dr. Young and also by Dr. Nathaniel P. Rathbun of Brooklyn, who discussed Dr. Young's paper. Another paper, presented at a later time on the program, by Dr. Douglas J. Roberts of Hartford, Conn., on "Ureteral Variations with Associated Kidney Changes," served to emphasize many of the points brought out by Dr. Young, and to illustrate the great variety of anomalies and pathologic conditions which may be demonstrated by roentgenologic examination of the urinary tract.

Another invited guest of the society, Mr. George W. Whiteside, delivered an address at the closing session on "Protection of the Roentgenologist against the Law Hazard in Roentgen-ray Therapy." As most roentgenologists know, Mr. Whiteside has had unusual experience in the protection of physicians against suits for malpractice and his address on this vitally interesting subject was very instructive. It will be published in full in an early issue of the Journal.

Among other papers presented during the meeting there were some of special note in that they reported findings or methods that are new. Dr. H. H. Hazen presented a new method for determining roentgen-ray dosage, his standard being the epilating dose in mice. Dr. Thomas R. Healy reported 47 cases of non-traumatic hernia of the stomach through the esophageal opening. This lesion has, of course, been observed before but its frequency as indicated by the number of cases reported by Dr. Healy has evidently not been sufficiently emphasized. Dr. H. A. Goalwin, of New York City, described a method for the precise measurement of the optic canals, seemingly much more exact than the methods described originally by L. E. White of Boston. Dr. A. H. Pirie showed an illuminating device which enables one to exhibit roentgen films in very rapid succession, and Dr. Pfahler described a new device for drying films and a method of combining the Holfelder field selectors with the Schmitz radium isodosis rings in treatment of uterine carcinoma.

There were many other papers of value and interest which cannot be mentioned here but which will be published in the Journal during the next few months.

Officers of the section elected for the ensuing year are as follows: Dr. Ralph D. Leonard, President; Dr. Howard E. Ashbury, Vice-President; Dr. Fred M. Hodges, Secretary.

RADIOLOGY

AMERICAN MEDICAL ASSOCIATION

At a recent meeting of the Council on Scientific Assembly of the American Medical Association, it was decided to devote three sessions of the section on "Miscellaneous Topics" to Radiology, at the meeting to be held at Atlantic City, May 25 to 29, inclusive.

All those who attended the Chicago meeting will recall the success, both in attendance and quality of the program, and it is hoped that all those interested in radiology will attend the meeting at Atlantic City. *When registering, please be sure to specify Radiology*, as the interest shown will determine whether a separate section will be granted next year.

The officers appointed were: Dr. P. M. Hickey, Chairman; Dr. Russell D. Carman, Vice-chairman; Dr. M. J. Hubeny, Secretary.

INTERNATIONAL CONGRESS OF RADIOLOGY

LONDON, JULY 1, 1925

Circulars have been mailed to many American radiologists announcing an International Congress of Radiology to be held in London, July 1–5, 1925. All American radiologists are invited to attend this Congress. Tours have been arranged through Thos. Cook & Son as follows:

OFFICIAL TOUR

Visiting
London, Oxford and Cambridge
Fare, $442.00

DAILY ITINERARY

Sat., June 20th: Sail from New York by United States Line S. S. "America" (22,622 tons).
Mon., June 29th: Arrive Plymouth—rail London.
Tues., June 30th to Sun., July 5th: At London. In Conference.
Mon., July 6th: To Oxford. (Short sight-seeing drive, visiting colleges). Proceed to Manchester.
Tues., July 7th: To Cambridge. (Short sight-seeing drive, visiting colleges). Return to London.
Wed., July 8th: Rail to Southampton and sail by S. S. "America" (22,622 tons).

The rate of $442.00 for the above tour includes an allowance of $300.00 plus $5.00 tax for trans-Atlantic passages by S. S. "America" together with first class rail tickets and accommodation at ordinary first class hotels, providing for bed in two bedded room and plain breakfast throughout.

For sightseeing as outlined, there will be an additional cost of $11.00 each person.

EXTENSION No. 1

Visiting
London, Oxford, Manchester, Glasgow, the Trossachs, Edinburgh and Paris
Fare, $630.00

DAILY ITINERARY

Sat., June 20th: Sail from New York by United States Line S. S. "America" (22,622 tons).
Mon., June 29th: Arrive Plymouth—rail London.
Tues., June 30th to Sun., July 5th: At London. In Conference.
Mon., July 6th: Rail to Oxford. (Short sight-seeing drive, visiting colleges).
Tues., July 7th: To Manchester.
Wed., July 8th: To Glasgow.
Thur., July 9th: By rail, coach and steamer through the Trossachs to Edinburgh.
Fri., July 10th: In Edinburgh. (Sight-seeing drive around the city.)
Sat., July 11th: Rail via the Cathedral route to London.
Sun., July 12th: Via Dover and Calais to Paris.
Mon., July 13th to Wed., July 15th: In Paris. (Sight-seeing on two days, visiting the city and Versailles).
Fri., July 17th: Rail to Cherbourg and sail for New York by S. S. "President Harding" (14,127 tons).

The rate of $630.00 for the above tour includes an allowance of $150.00 for outward trans-Altantic passage plus $5.00 war tax by "America," and $230.00 for passage by "President Harding," together with first class rail tickets and accommodation at ordinary first class hotels providing for bed in two bedded room and plain breakfast throughout.

For the sightseeing as outlined, there will be an additional cost of $23.00 each person.

EXTENSION No. 2

Visiting
London, Oxford, Manchester, Glasgow, the Trossachs, Edinburgh, Newcastle, Bergen, Christiania, Stockholm, Gothenburg, Copenhagen, Hamburg, Bremen
Fare, $669.00

DAILY ITINERARY

Sat., June 20th: Sail from New York by United States Line S. S. "America" (26,622 tons).
Mon., June 29th: Arrive Plymouth—rail London.
Tues., June 30th to Sun., July 5th: At London. In Conference.
Mon., July 6th: Rail to Oxford. (Short sight-seeing drive, visiting the Colleges).
Tues., July 5th: To Manchester.
Wed., July 8th: To Glasgow.
Thur., July 9th: By rail, coach and steamer through the Trossachs to Edinburgh.
Fri., July 10th: In Edinburgh. (Sight-seeing drive around the city.)
Sat., July 11th: Rail to Newcastle and embark on B. & N. steamer.
Sun., July 12th: Arrive Bergen P. M.
Mon., July 13th: Rail to Christiania.
Tues., July 14th and Wed., July 15th: In Christiania.
Thur., July 16th: Rail to Stockholm.
Fri., July 17th to Mon., July 20th: In Stockholm.
Tues., July 21st: Via Gota Canal to Gothenburg.
Wed., July 22nd: On Canal steamer.
Thur., July 23rd: Arrive Gothenburg.
Fri., July 24th: In Gothenburg.
Sat., July 25th: Rail to Copenhagen.
Sun., July 26th: In Copenhagen.
Mon., July 27th: Rail to Hamburg.
Tues., July 28th: To Bremen and sail for New York by S. S. "Republic" (18,022 tons).

The rate of $669.00 for the above tour include an allowance of $300.00 for trans-Atlantic passages by S. S. "America" and "Republic" plus $5.00 war tax, to-together with first class rail tickets and accommodations at ordinary first class hotels providing for bed in two-bedded room and plain breakfast throughout.

For sightseeing as outlined there will be an additional cost of $23.00 each person.

Application blanks will be sent upon request to Thos. Cook & Son, 585 Fifth Avenue, New York City.

The following memorandum of arrangements has been received from Dr. Robert Knox, chairman of the Organising Committee.

The Organising Committee has pleasure in announcing that it has been decided to hold a Congress of Radiology in London in July, 1925. The arrangements are being made jointly by the Electro-therapeutic Section of the Royal Society of Medicine, the Roentgen Society, and the British Institute of Radiology.

The Congress will be of an International character inasmuch as Radiologists from every country are invited to take part. Its objects are to bring together Radiologists from all parts of the World to discuss subjects of interest, and to secure the formation of a comprehensive International Committee and the establishment of a full International Congress to be held at stated intervals in different countries. It is hoped that at this London Congress arrangements will be made for the First International Congress, and that the date, and the country in which it will be held, will be decided upon by the International Committee.

Electro-therapeutics and allied subjects will be included in the scope of the Congress.

SOCIETIES

Radiological and Electro-therapeutic Societies are invited to send approved representatives who shall be eligible to serve on the International Committee. Societies are requested to bring the Congress to the notice of their members and to secure the attendance of as many as possible.

EXHIBITIONS

In connection with the Congress there will be an Exhibition of Radiological and Electrical apparatus. The exhibition will be open during the four days of the Congress, and there will be an official visit to the exhibition. Firms wishing to exhibit should apply for particulars.

There will also be an Exhibition of Radiograms in which Dental Radiograms will be included.

DATES

The opening Meeting of the Congress will take place on the morning of Wednesday, July 1st, 1925, and the other sessions will extend over that and the following days, ending on Saturday, July 4th. In the following week arrangements will be made for visits to other centres of interest.

On the evening of Tuesday, June 30th, a reception will be held so that Delegates and Members may have an opportunity of meeting before the opening of the Congress.

PAPERS

All papers intended to be read at the Congress must be sent to the Secretary General, at the British Institute of Radiology, not later than May 1st, accompanied by a short abstract. It is particularly desirable that papers should, wherever possible, be approved by a recognised Society of which the author is a member. All papers and abstracts must be typewritten or printed, and English translations will be much appreciated.

Authors will be notified of acceptance or otherwise of their papers as soon as possible after their receipt.

Each paper read at the Congress will be in the language selected by the author.

It is intended to publish Papers read at the Congress in the *British Journal of Radiology*.

MEMBERSHIP

It is hoped that all who wish to attend the Congress will signify their intention as soon as possible so that some estimate may be made of the numbers attending.

The fee for Membership of the Congress will be two guineas (£2 2 0).

TRAVEL AND ACCOMMODATION

Arrangements are being made through an agency for travelling facilities and hotel accommodation. Particulars will be sent on application to the Secretaries.

Further particulars will be announced in due course, and the fullest possible information will be given to those applying. Correspondence and suggestions on any matter in connection with the Congress are cordially invited.

ADDRESS

The house of the British Institute of Radiology will be used as the administrative centre for the Congress. An information Bureau with interpreters will be provided.

All communication should be addressed to:

THE SECRETARIES, INTERNATIONAL CONGRESS OF RADIOLOGY,
c/o THE BRITISH INSTITUTE OF RADIOLOGY,
32 Welbeck Street, London, W.1.
32, WELBECK STREET, LONDON, W.1.
January, 1925.
Telephone: Mayfair 3273.
Telegraphic Address: Britology, Wesdo, London.
Cable Address: Britology, London.

MEETINGS OF THE ROENTGEN SOCIETIES

We contemplate the publication of a list of roentgen society meetings such as that below, in each issue of the Journal, gradually adding other home and foreign societies as the information reaches us. Secretaries of societies not here listed are requested to send the necessary information to the editor.

New York Roentgen Society
Secretary, Dr. Eugene V. Powell, 217 East 42d St.
Meets monthly on second Monday, New York Academy of Medicine.

The Canadian Radiological Society
Secretary, Dr. E. C. Brooks, Montreal.
Annual meeting, Regina, Sask., June 15–19, 1925.

Roentgen Ray Society of Central Pennsylvania
Secretary, Dr. W. E. Reiley, Clearfield, Penna.
Two meetings a year, April and October.

The New England Roentgen Ray Society
Secretary, Dr. Frank E. Wheatley, 520 Beacon St., Boston, Mass.
Meets monthly on third Friday, Boston Medical Library.

Philadelphia Roentgen Ray Society
Secretary, Dr. Eugene Pendergrass, University of Pennsylvania, Philadelphia.
Meets monthly on first Thursday evening, Pennsylvania Hospital.

Chicago Roentgen Society
Secretary, Dr. Edward S. Blaine, 2005 S. Wabash Ave.
Meets monthly on second Friday from October to May (except during month of December) at Virginia Hotel. Dinner at 6 P.M., scientific session at 8 P.M.

The Societa Italiana di Radiologia Medica, founded in October, 1913, gathered practically all the specialists of radiology in Italy. Five congresses have already been held by this Society—Milan, 1916, Genoa, 1919, Rome, 1920, Bologna, 1922, Palarme, 1923. The next congress will take place at Trieste in the spring of 1925 (the exact date not yet received), and Professor Gortan will be the president. Actually the president of the Societa Italiana di Radiologia Medica is Professor Bertolotti, Turin, and Professor Ponsio, Turin, is the secretary-treasurer. The "La Radiologia Medica" is the official organ of the Society and is published monthly.

RADIUM FOGGING OF ROENTGEN FILMS

In a recent communication from Mr. M. B. Hodgson, Manager of the Medical Division of the Eastman Kodak Company, request is made to reprint an article by Dr. Pfahler on page 580 of the December number of the Journal entitled "A Safety Device for the Care of Radium Contained in Needles and Capsules." Mr. Hodgson states, "There has been widespread damage to *x*-ray films by radium fogging and I believe that if this angle is called to the attention of roentgenologists using radium, it would be of considerable benefit."

To the Editor,
American Journal of Roentgenology and Radium Therapy.

The accompanying roentgenograms are taken of both feet of the same patient. The left side is normal, but on the right side there appear to be three separate ossicles behind the posterior extremity of the astragalo-calcaneal joint, much in the position of the frequently occurring os trigonum.

Since multiple ossicles in this region do not appear to have been described, a record of this abnormality might be of interest.

H. FLECKER.

Melbourne, Australia.

Multiple ossa trigona.

DEPARTMENT OF TECHNIQUE

Department Editor: DAVID R. BOWEN, M.D., Pennsylvania Hospital, Philadelphia, Pa.

In this department will be published from time to time, as material is available, suggestions for improvement in technique.

AT-A-GLANCE EXPOSURE CHART

BY H. L. SAMPSON

TRUDEAU, NEW YORK

So many articles have been written in the past on exposure technique that it might seem unnecessary at this date to suggest anything new in the way of an exposure table. However, the author has found the accompanying table of so much value, that it is offered not as something radically new, but as a working guide, which has been in use for seven years and is built upon actual results in each instance.

A word of explanation may be permitted as a preliminary. If a given object is roentgenographed at successive times under identical conditions the resulting films should be the same. Upon this theory the enclosed table is constructed. To reproduce these identical conditions, or constants, is therefore a matter of extreme importance. However, there are some factors over which an operator does not have complete control. For instance, we have noted that two transformers of different makes of the modern type operating under apparently identical conditions (carefully checked) will show perceptible differences in the resulting films, a possible explanation being that the transformers are constructed differently and in one there may be an internal lag causing in short exposures an appreciable effect. There is another variable that is particularly difficult to calculate. The same depth or thickness of tissue in a child may not have the same absorptive coefficient as that of an adult, for the reason that the child's tissues are more delicate, and with the same exposure the resulting films would be definitely denser, also in adults' chests the lung or air depth may have a different ratio for the same depths of chests as may be present in emphysema; this ratio of air or lung depth to chest depth may also vary in normal individuals. Nevertheless we can make reasonable allowances in many instances that work out very satisfactorily. With these and possibly other shortcomings ever present in operating with a given technique we have attempted to tabulate exposures for all parts of the body using but one variable, "the time," this being decided according to the thickness or depth of the part to be roentgenographed. In the table it is to be noted that * and ** indicate some deviation in technique. However these deviations should not be looked upon as variables, as once decided upon they are not altered or varied for different depths of tissues.[1] In other words, after having decided that diaphragm and double screens give good results for heavy parts, they cease to be variables and only their time factors have to be considered. This is well demonstrated in the spinal work where the Potter-Bucky diaphragm gives excellent results, the only variable under these conditions being the time. As another illustration, it is not to be inferred that in chest work direct films are superior to those taken with double screens. In fact, with heavy patients the screen film is decidedly better, having more brilliancy and is probably preferable from a diagnostic point of view. So if one prefers screen work, the screen is eliminated as a variable, but if chest work is done alternately with the direct method and by the use of screens, another variable, the screen factor, has always to be considered. Different films also differ in ratio as to use with and without intensifying screens.

Some positions that have to be assumed in taking different parts of the body have not been taken care of in the accompanying chart, namely, exposures for the mastoids, oblique exposures of the hip, exposure for

[1] In Potter-Bucky diaphragm work the ratio changes somewhat for different thicknesses.

the Bowen position of the head from above down, oblique position of the shoulder, lateral position of the chest for lungs, for the reason that the exposures for these positions can very easily be calculated, based upon the standard position of the above mentioned parts and figured accordingly to the depth of the part penetrated. It is not the intention of the author to offer the accompanying table as the only one that will produce good results, but merely as a general guide, using standards which produce satisfactory results, and which are capable of reduplication within reasonable limits, also having the advantage that very little calculation is necessary once the various standards have been adopted. The reason for noting a given make of films and developer, also the type of tube used, is because all the exposures were determined under those conditions. The exposures are written below the line in seconds and tenths of seconds; the depth or thickness of the part above the line, except in the case of teeth where the exposures are calculated on the weight.

The accompanying table has been possible only through the painstaking efforts of Mr. Von Wecheln and Mr. Autenreith.

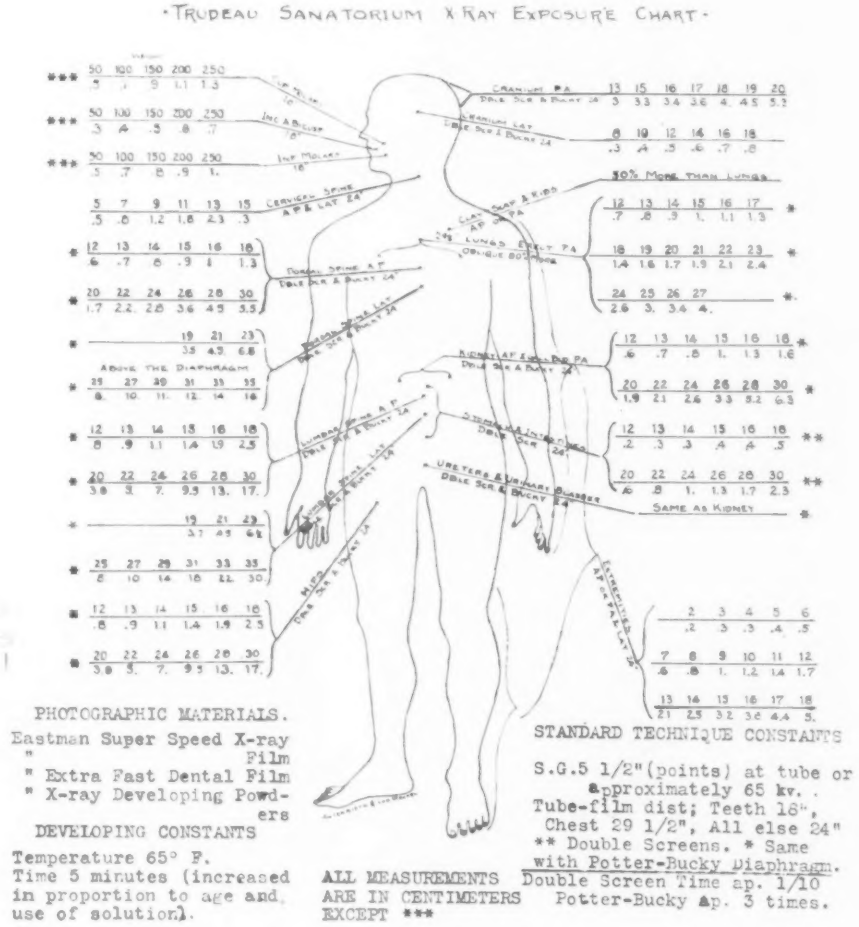

·TRUDEAU SANATORIUM X RAY EXPOSURE CHART·
PHOTOGRAPHIC MATERIALS.
Eastman Super Speed X-ray Film
" Extra Fast Dental Film
" X-ray Developing Powders
DEVELOPING CONSTANTS
Temperature 65° F.
Time 5 minutes (increased in proportion to age and use of solution).
ALL MEASUREMENTS ARE IN CENTIMETERS EXCEPT ***
STANDARD TECHNIQUE CONSTANTS
S.G.5 1/2"(points) at tube or approximately 65 kv.
Tube-film dist; Teeth 18", Chest 29 1/2", All else 24"
** Double Screens. * Same with Potter-Bucky Diaphragm.
Double Screen Time ap. 1/10
Potter-Bucky Ap. 3 times.

FIG. 1.

A RADIUM SPOOL FOR TREATING CARCINOMA OF THE CERVIX

BY CHAS. L. MARTIN, M.D., AND JAMES M. MARTIN, M.D.

DALLAS, TEXAS

IN observing our cases of carcinoma of the cervix over a period of several years we were struck with the frequency of broad ligament extension which continued to grow and cause symptoms after all vaginal evidence of the disease had vanished. Bailey has called attention to the fact that only small doses of unprotected radium can be used in the vagina if bladder and rectal injury is to be avoided. However, the vaginal vaults offer the most favorable site for radium that is to be used in treating the broad ligaments. Bailey has devised the "bomb" which utilizes large amounts of radium emanation and directs a comparatively limited cone of rays into the sides of the pelvis. This ingenious device protects the bladder and rectum from injury and should produce retrogression in the malignant tissue towards which it can be directed, although it would seem to us that its weight might make the accurate direction of the cone of rays somewhat difficult.

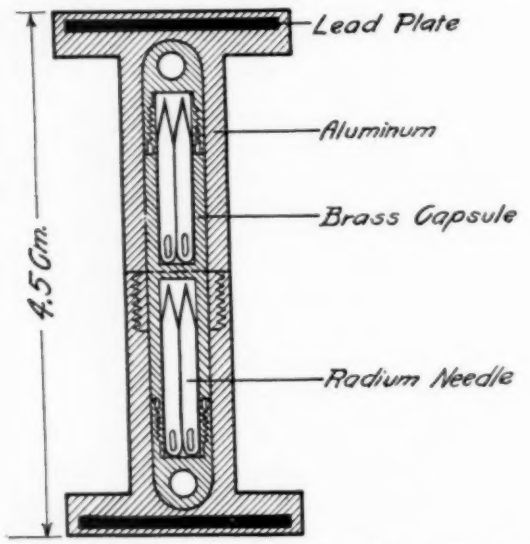


FIG. 1. Vertical cross section of "spool" assembled and ready for use.

FIG. 2. Photograph of two "spools" partially assembled showing the flexibility of the apparatus.

Since we do not have large amounts of radium element, or emanation available, we have devised a "spool" for the treatment of the broad ligaments. It was our desire to construct an applicator which required a relatively small amount of radium but was so designed that it might remain in place comfortably for a long period of time. Since a small amount of radium was available we wished to make use of the maximum amount of radiant energy rather than a single cone of rays, and also to distribute this energy as evenly as possible over all of the structure passing out laterally from the cervix.

A vertical cross section of the "spool" is shown in Figure 1. The needles are of the small type and each contains 6.25 mg. of radium. The two compartments in the brass capsule prevent the needles from falling together and produce a cross fire of the structures near the center of the "spool." Twenty-five mg. silver capsules could be placed in these compartments. The brass capsule as well as the protective lead plates in the ends of the "spool" are

completely surrounded by aluminum and this makes unnecessary the use of a rubber covering. The brass capsule may be removed from the aluminum spool and used for direct insertion into the uterus or cervical canal and the needles may be removed from the capsule and inserted directly into malignant tissue when this is deemed necessary. Photographs of two spools partially assembled are shown in Figure 2.

not observed any evidence of treatment sickness during their use. An ample gauze pack holds them upright and also takes care of any hemorrhage resulting from their insertion.

By referring to Figure 3, it may be seen that more than half of the available radiant energy is being directed either into the primary tumor or into the broad ligament, whereas the direct rays coming from the ends of the capsule are partially blocked

FIG. 3. A vertical section of the female pelvis cut slightly off center so as to show the relationship of the "spool" and the lymph channels of the broad ligaments.

One of the spools is shown in position in Figure 3. On first thought the "spool" may appear to be too long but it is desirable to push the bladder and rectum away from the radium as far as possible and also to spread out the lymphatics of the broad ligament along the side of the barrel of the "spool" so that they may be evenly irradiated. We use two of these devices, placing one on either side of the cervical mass. It sometimes requires considerable patience to place them correctly, but they do not produce discomfort and we have

by the lead plates so that the bladder and rectum receive considerable protection. It might seem necessary to use more protection in the spool ends but the fact that the ray intensity from the end of a capsule is considerably less than from the sides makes the needed protection somewhat less than might at first seem necessary. In certain cases the new growth fills all of the upper vagina. Under these circumstances the two spools are placed upright side by side against the neoplasm and on the next day a capsule

containing the eight needles is placed in the cervical canal. After the tumor recedes it is possible to place the spools in the vaults.

The upper vagina is sometimes so contracted either from the malignant invasion or previous treatment that there is not enough room in it for the "spools." A shorter set is being constructed for such cases. These "spools" will contain brass capsules with single compartments large enough to contain four needles.

The device that we have described is, of course, not applicable to all cases, but it has often proven satisfactory when used in connection with radium in the cervical canal and deep roentgen therapy. It has seemed less hazardous to push the roentgen-ray attack when the vaginal applications have been made in this way.

BOOK REVIEWS

Books Received Are Acknowledged under Heading: Books Received. This must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

X-RAYS AND X-RAY APPARATUS. An Elementary Course. By John K. Robertson, Associate Professor of Physics, Queen's University, Kingston, Canada. Cloth. Pp. 228, with 112 illustrations. New York: The Macmillan Co., 1924.

The problem of medical educators is a particularly difficult one. Medical science is becoming more and more an application of the laws of physics and chemistry, yet in the process of medical training there usually is a rather wide gap of time between the training in these fundamental sciences and their applications. How is the harassed medical student to overcome this handicap? How shall the medical educator plan courses intelligently and efficiently? The problem is perennial and the solution still far off.

Neither roentgenologists nor even physicists can be expected to be familiar with the detailed construction of the various pieces of apparatus comprising the modern roentgenologist's armamentarium. That is distinctly the field of the electrical engineer. But the intelligent operation of the apparatus clearly demands an understanding of the basic principles involved in the instrument used. The application of any branch of science cannot be successfully taught or understood without a knowledge of fundamental principles.

Dr. Robertson in constructing this treatise has kept these considerations in mind and has produced a worth while work. It is intended as a basis of instruction in the physical side of roentgenology in medical schools and hospitals, and assumes but a very elementary knowledge in the reader. Brief but adequate description is given of all the essentials of the interrupterless transformer, the induction coil, the origin of roentgen rays, the gas bulb, the Coolidge tube, the penetrating effect of roentgen rays, the nature of roentgen rays, the measurement of wave length, secondary roentgen rays, dosage, dosage by ionization, and deep therapy. An aspect that will appeal to the student is the wealth of explanatory diagrams. To the reviewer these constitute a most important part of the work. Dr. Robertson has managed to keep at a minimum the half tone illustrations from manufacturers' catalogues which are rarely reproduced clearly and which possess a low instructional value.

The text contains numerous illustrative numerical examples; and it would seem that although the beginner might not welcome it the inclusion of a few problems at the end of each chapter would be of great value to the thoughtful student.

This elementary text should successfully fulfill its purpose. The beginner will find the presentation beset with comparatively few difficulties and the subtle infiltration of the radio into modern life will at least have made the reader receptive to the principles outlined if he has not already become well grounded in them. BARNETT COHEN.

AMERICAN ANNUAL OF PHOTOGRAPHY, 1925. Volume xxxix, Edited by Percy Y. Howe. Paper. Price, $1.75. Cloth. Price, $2.50. New York: The American Annual of Photography, Inc., 1924.

A camera in the hands of the average person produces pictures which rarely do credit to the operator, subject or manufacturer.

To those who aspire to photographic results which are worth the effort there is no guide equal to the American Photographic Annual, and in the 1925 edition the comprehensive articles on every day photography are especially noteworthy.

Even a superficial survey of the many charming illustrations must stimulate the reader to admiration if not emulation.

A DESCRIPTIVE ATLAS OF RADIOGRAPHS OF THE BONES AND JOINTS. By A. P. Bertwistle, M.B., Ch.B. Leeds, Resident Surgical Officer, General Infirmary, at Leeds. Cloth. Price, $5.00. Pp. 198, with 299 illustrations. New York: William Wood and Company, 1924.

The use of silhouette roentgenograms is very effective, giving prints which more nearly approach the original roentgenograms.

The parts on normal bones and epiphyses, fractures, diseases of bones, injuries, and diseases of joints, and congenital deformities are well and completely illustrated.

The legend is entirely in English, is complete and arranged on the page facing the illustrations.

The book can be especially recommended for students and practitioners.

INTERNATIONAL ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

ROENTGEN DIAGNOSIS

DUNHAM, KENNON, AND NORTON, VERA. Observations of annular shadows and cavities at the Cincinnati Tuberculosis Sanatorium. *Am. Rev. Tuberc., Balt.*, November, 1924, x, 306–318.

It is important to differentiate between annular shadows caused by localized air pockets or pleural changes and annular shadows due to cavities, because thin walled cavities indicate a very grave prognosis and necessitate application of pneumothorax.

In 67 cases, 23 showed annular shadows which were proved by pneumothorax to be cavities; 32 were annular shadows proved to be due to cavity by roentgen-ray studies extending over a long time. In all of the 67 cases the sputum was positive for tubercle bacilli and all but 4 had one or more annular shadows on the roentgen-ray plate. The shadow consisted of an area of decreased density surrounded by an area of increased density. All the lesions in the lower lobes were confined to the upper third of the lobe. It is concluded that most annular shadows are due to cavity and that most of the latter have thin walls. Such thin walled cavities are a serious menace to the life of the patient. The best means of diagnosing them is by inducing pneumothorax. This procedure also has the advantage of being the treatment of choice.

FLEISCHNER, FELIX. Diverticulum of the stomach near the cardia. *Klin. Wchnschr.*, Sept. 2, 1924, iii, 1619–1621.

A report is given of 2 cases observed roentgenologically and confirmed anatomically. They compare in characteristics with some descriptions found in the literature and appear to constitute a special group. They are characterized roentgenologically by the following features, and may thus be differentiated from perforating ulcer or tumor crater. They appear to lie about 2 to 3 fingers above the cardiac end of the stomach at the small curvature or somewhat dorsal to it. The sizes observed up to the present are from the size of a cherry to that of a plum. When drinking the fluid shoots directly against the sac and expands it smoothly. Residue of contrast material is demonstrable 5 to 24 hours after the rest of the stomach has emptied. Above this residue there is to be observed an air bubble. The stomach wall in its vicinity shows no sign of infiltration.

In addition to the local disposition or weakness of the stomach wall, the factor of mechanical loading is important in determining the formation of this type of diverticulum. Analogous to the Zenker diverticulum of the pharynx, this form of gastric diverticulum is regarded as a pulsion diverticulum.

HOLMES, GEORGE W. Some observations on use of roentgen ray in diagnosis of pericarditis. *J. Am. M. Ass.*, Nov. 29, 1924, lxxxiii, 1745–1747.

Experimental work on fresh hearts suspended in mediums of varying specific gravity showed the heart visible as a shadow of increased density until the specific gravity of the surrounding medium reached 1.000 when it disappeared. It again became visible as a shadow of diminished density when the specific gravity reached 1.036. That is, the shadow of the heart itself was not visible when the density of the medium surrounding it corresponded to that of pericardial effusions.

Other experiments consisted in the injection of the pericardium in the cadaver. It was found that the earliest changes in the shape of the heart shadow are seen in the region of the sinus at the base of the heart, and along the posterior border. In the anteroposterior view of the shadow there is a widening of the supracardiac area and obliteration of the normal curve of the left auricle with the injection of about 200 c.c.

From clinical data in 60 cases and from a review of the literature it is concluded that the roentgenographic findings in their order of importance in pericarditis with effusion are: enlargement of the heart shadow; abnormal shape of the heart shadow; change of shape with a change of position of the patient; obliteration of the normal outline of the various chambers of the heart; changes in the shape of the angle formed by the posterior border of the heart, the diaphragm and the spine; and faint or absent pulsations.

The technique consisted of the roentgenographic study of the heart with the patient upright and the screen in front, with the tube about 30 inches behind. A tracing was made of the outline of the heart during quiet breathing and during forced expiration and inspiration. In addition a plate was taken at a target-screen distance of 7 feet, with the patient seated and the plate in front.

In a total of 2,950 heart examinations, roentgen-ray evidence of disease of the peri-

cardium was found in 36. These findings were not confirmed in 15 of the 36 cases.

With the combined method of roentgenoscopy and teleroentgenography, one should be able to make a diagnosis of pericarditis in a fair percentage of cases examined. The variations from the normal that are to be sought are: (1) enlargement of the heart shadow with a tendency to assume the triangular or "water bottle" shape; (2) obliteration of the normal cardiac outline, with inability to distinguish the pulations of the auricles from those of the ventricles; (3) change in shape with change in position whenever fluid is present; (4) in the presence of adhesions the respiratory movements of the heart may be limited and its outline irregular.

KIDNER, F. C., AND MURO, FELIPE. Köhler's disease of the tarsal scaphoid or os naviculare pedis retardatum. *J. Am. M. Ass.*, Nov. 22, 1924, lxxxiii, 1650–1654.

The name Köhler's disease has been given to two distinct pathological entities. One of these occurs in the head of the second metatarsal, and the other in the scaphoid of the tarsus. An accurate descriptive name suggested for this condition is the term, os naviculare pedis retardatum. A case occurring in a boy, aged eight, is reported on from the clinical and pathological points of view. The clinical examination is of little importance, and the roentgen-ray findings are of great importance. The bony nucleus of the scaphoid appears denser than normal, ragged in outline, and is decreased in size of all diameters. The anteroposterior diameter seems to be shortened more than the side to side diameter. This is probably not a fact but an illusion. There is moderate swelling and thickening of the visible soft parts. The surrounding bones all give normal shadows, and there is no notable calcium absorption. The increased density of the scaphoid nucleus is apparently due to a decrease in the size of the canaliculi with consequent shrinkage of the lime-containing bone elements. The density does not seem to be due to actual increase in the amount of calcium salts. Sometimes there is a tendency to fragmentation of the nucleus, but it never breaks up into separate elements.

The disease unquestionably resembles Legg-Perthes' disease of the hip in its symptoms and roengenographic appearances. It is believed that Köhler's disease is an interference with the bone production in the scaphoid of the foot, the interference being due to low grade infection, the source of which is unknown. The infection attacks the scaphoid because it is the bone in the arch of the foot bearing the greatest strain, and because it has the poorest blood supply of any of the bones of the tarsus. Trauma undoubtedly plays a part.

MATHER, J. H. X-ray examination in relation to some aspects of pulmonary tuberculosis. *Brit. M. J.*, Oct. 4, 1924, No. 3327, 615–617.

Where the evidence gleaned from the physical examination of the chest is not sufficient to account for the symptoms, the roentgenologic examination may be of supreme value in fixing the diagnosis of tuberculosis. There are 5 types. In the first the roentgenogram shows extensive symmetrical mottling of the lungs with restricted movement of the diaphragm. Three such cases are described in which there was no evidence to suggest the presence of emphysema and the lesions were well marked.

The second type comprises cases sent for roentgenographic examination of the chest to confirm a clinical diagnosis of a tuberculous lesion at one apex. There is disclosed, however, extensive mottled shadowing of the whole of both sides of the chest with the exception of the unsuspected apex. The failure to diagnose cases of symmetrical disease is probably due to the lack of a basis for comparison of the percussion sounds in the two lungs. In the third type found in insurance cases, the physician can detect no physical signs but hesitates to give a clean bill of health as possibly the patient may have been in a sanatorium immediately preceding. The roentgenographic examination in such cases frequently reveals calcareous patches, usually in the region of the apices, pointing to an old healed lesion. Such a case is described. Type IV includes cases of cervical rib, the presence of which is unsuspected, gives rise to some lagging at the apex, slight dullness on percussion and rather distant breath sounds, thus simulating an apical lesion. A chest in which there is marked scoliosis combined with kyphosis gives rise to considerable difficulty in diagnosis, especially when the physician is required to make a negative diagnosis of tuberculous disease. This constitutes Type V and is illustrated by a case cited.

SIMON, GEORG. Interpretation of the roentgenogram in the diagnosis of juvenile pulmonary tuberculosis. *Ztschr. f. Tuberk., Leipz.*, April, 1924, xl, 34–38.

During the past year, six boys and six girls, aged eight to fifteen, were sent to the sanatorium with the diagnosis of pulmonary tuberculosis. It appears that this diagnosis was based largely upon the roentgenographic findings. The children all gave negative tuberculin reactions and in none of them were there any

definite physical signs of lung infiltration. The roentgen findings consisted of broad hilic areas with or without shadows, and marked fibrotic streaks. Attached to the latter mostly, and lying partly free were small spots of the size of hempseed scattered in the upper and middle fields, rarely extending farther down.

An analysis of the findings disclosed that the gland enlargements and connective tissue proliferation were due mostly to influenza, pneumonia, measles and whooping cough through which these children had previously passed. Moreover, the roentgenograms were taken with too soft a tube, which causes the appearance of small shadows, especially in the upper half of the plate. Under these conditions a normal lung may have the appearance of one with productive tuberculosis.

Weigel, B. J. Intrapulmonary cavitation in tuberculosis. A clinical, laboratory and *x*-ray study of 125 patients. *Am. Rev. Tuberc., Balt.*, November, 1924, x, 319–328.

Neither the clinician upon his finding alone, nor the roentgenologist on his can be positive that cavitation exists. There must be correlation between history, physical findings, laboratory and roentgen-ray, before definite conclusions are justified. The findings in 125 cases at the Albuquerque Sanitorium are tabulated to determine the frequency with which physical signs corroborated roentgen-ray and other findings. The cases all had cavities of 2×2 cm., or larger. All cases but one had positive sputum for a long period. Cavitation was left sided in 41 per cent of the cases, right sided in 40 per cent, and bilateral in 19 per cent. In 15 per cent of the cases the cavities were limited to the apex. Ring shadows, after excluding bronchiectasis in cases with persistently positive sputum, must be considered as tuberculous cavities. When a doubtful ring shadow appears on the roentgen-ray film the burden of proof should be placed on the side disputing the existence of true cavitation. The use of the roentgenoscope is emphasized as valuable if the rarefied area can be detected under the screen; and if on moving the patient a fluctuating fluid level is discerned, one is positive of cavitation. It seems to be the exception rather than the rule for definite cavity signs to be present in far advanced, practically moribund cases.

Out of the 175 cavities found in these patients, only 26 or 14.8 per cent were diagnosed on physical examination alone. History, clinical and laboratory findings when correlated with the roentgen-ray findings constitute the only means of definitely diagnosing cavitation. Persistently positive sputum in the absence of bronchiectasis must, as a rule, be considered indicative of destruction of lung tissue.

Achard, Ch., and Thiers, J. Syphilitic arteritis of the lower limbs. Roentgenography of the arteries. *Bull. et mém. Soc. méd. d. hôp. de Par.*, Apr. 17, 1924, 3. s., xl, 533–535.

Labbé, Delherm and Lenfantin have reported the successful use of the roentgenogram in observing arteritis in cases of diabetes, in which the arterial lesions were easily studied. In the present paper, the roentgenogram is used for a similar purpose in cases of syphilitic arteritis. A case report is given in which this was successfully accomplished. The patient had had a chancre a number of years, and showed a strong positive Wassermann reaction. The usual symptoms of arteritis were present, but in this case, further developments had taken place. On the left side, an arterial obliteration had produced a limited gangrene of one of the toes and atrophy of the muscles; on the right side an aneurysm below the knee was found. The roentgenogram showed long, dark lines following the arteries which showed that the walls of the arteries had become calcified. There was further evidence of this in that no pulse beats were discernible in the calcified arteries.

Armand-Delille, M. P.-F. Contribution to the study of bronchial dilatations in children by means of intratracheal injections of lipiodol. *Bull. et mém. Soc. méd. d. hôp. de Par.*, Mar. 20, 1924, 3. s., xl, 344–346.

Two new cases are reported in which intratracheal injections of lipiodol were used. In the first case, the left lung was roentgenographed in the horizontal position, in which position a large number of shadows were observed which resembled large nuts and which blended one with the other. In the second case, in which the lesions were less extensive, there were observed in the left lung, in the horizontal position, a series of circular shadows of about the size of raisins. In the vertical position, the liquid forms a deposit in the bottom of the cavities forming a crecent-shaped shadow. In this way, using both horizontal and vertical positions, a clear conception of the exact topography and the extent of the lesions can be determined. This method is of particular value in showing lesions in the lung which will not be apparent by any other method, or certainly not so clearly and definitely. Care must be exercised not to interpret as bronchial dilatation the infiltration of the oil into the emphysematous area, and also to distinguish between the dilatation of the bronchi and the bronchioles

which are outlined by the oil and which appear larger because they are farther removed from the field of focus, being near the thoracic wall.

ARMAND-DELILLE, P., DUHAMEL, G., AND MARTY, P. The diagnosis of bronchial dilatation in the infant by means of lipiodol. *Presse méd., Par.*, May 14, 1924, No. 39, 421–425.

Because of the difficulty of diagnosing bronchial dilatation in children, not only because of the difficult interpretation of stethoscopic indications, but also because of the uncertainty of sputum diagnosis, the use of lipiodol was introduced into roentgenology by Sicard and Forestier. This allows for exact observation of the anatomic lesions and the arrangement of the cavities of the lung in detail. The writers have been prompted to make use of this principle in the diagnosis of such affections in children for the above reasons, and offer many excellent roentgenograms to show how clearly the condition of the lung cavity may be studied by this method. Tuberculosis, which is often difficult to recognize in children, is easily diagnosed by the roentgenogram when lipiodol is first injected. The picture obtained is much clearer than that secured without lipiodol. The injection of this substance is accomplished as follows: a strong syringe of 20 c.c. capacity, with trocar attachment is used and injection made intercricothyroidly. A special curved trocar is used, because the needle proposed by Sergent and Cottenot is not suitable for children, because of their excitability and the danger from this cause. After morphine and sedol injection in the area to be injected with lipiodol, the latter is then introduced intercricothyroidly, and the roentgenogram taken as soon as it reaches the bronchioles. Aseptic precautions, of course, obtain throughout, and tincture of iodine is applied after the trocar is removed. About 2 c.c. are injected in 40 seconds; 8 to 10 c.c. are sufficient for a child 7 to 14 years old, the time necessary for the total amount being about 4 to 6 minutes. The illustrations show that these roentgenograms are exceptionally clear and give information from which diagnosis is rendered much easier.

CARNOT, P., AND PERON, N. Large diverticulum of the fourth portion of the duodenum. *Bull. et mém. Soc. méd. d. hôp. de Par.*, July 31, 1924, 3. s., xl, 1222–1224.

A case is reported of a large diverticulum adjoining the angle of the duodenum and jejunum in which the roentgenographic findings were confirmed by autopsy. This condition was not determined by clinical examination and was brought out only by means of the roentgenogram. Barium oxide was given and the roentgenogram taken, the various portions of the digestive tract being very clearly shown. The enlargement was found to be about 55 by 45 mm., and to be separated into two divisions. The lower portion was very opaque, due to the baryta, while the upper portion was clear, and had the appearance of a bubble of air surmounted by an opaque liquid. There was evident distention of the angle due to stasis, showing a definite diverticulum. Six days later, the patient returned suffering from paraplegia, which was probably caused by obstruction of an artery near the 8th dorsal segment. After several days, the patient died of bronchopneumonia. At autopsy, these roentgenographic findings were confirmed. The diverticulum at the angle of the duodenum and jejunum was the only portion of the digestive tract that was abnormal. The dimensions of the sac were the same as found in the roentgenogram, 55×45 mm. This condition is rare, and the clinical symptoms are vague. The roentgenogram is necessary for correct diagnosis.

CESTAN AND RISER. Cerebral ventriculography by gas injected through the spinal column. *Bull. et mém. Soc. méd. d. hôp. de Par.*, July 3, 1924, 3. s., xl, 953–961.

Injection of sterile air into certain organs has made possible roentgenograms of these organs to show the topography of the air spaces so formed. In the present paper, this principle is applied to the roentgenographic study of cerebral ventricles, noting especially the situation, dimensions, and the deformation of the ventricles, as well as studying the degree of occlusion of the spaces, etc. The method used is to withdraw gradually, spinal fluid 5 c.c. at a time, by lumbar puncture and to add 5 c.c. of air each time, until 30 c.c. to 40 c.c. of air have been injected. The ventriculogram is then made from any position desired, so that air spaces may be noted in the ventricles. The roentgenogram is made in about 5 minutes after injection. The reactions which follow injections of air are of two types: (1) clinical, —hyperesthesia, vomiting, stiffness of the neck, etc.; (2) functional, in which functional disturbances are noted, headache and vomiting being the only important ones. Quietness and injections of atropin sulphate are then recommended. It is rare that these symptoms last for more than 24 hours, but sometimes the headache and vomiting continue for 4 days. There is not any relation between the humoral reactions and the clinical symptoms. This method of ventriculography, however, will

not reveal obscure tumors. The ventricles and their form can be easily studied, allowing observation of normal and abnormal arrangement of these spaces. It is necessary to have clearly in mind the normal in such studies. Hydrencephalocele is readily diagnosed in this way. Infantile encephalopathy can be diagnosed by this method, as well as other similar conditions. The technique is sufficiently simple to allow for general use in such cases.

CAUSSADE, G., MOULONGUET-DOLÉRIS, P., AND SURMONT, J. On a case of myeloma of the right foot with multiple metastases. *Bull. et mém. Soc. méd. d. hôp. de Par.*, Apr. 17, 1924, 3. s., xl, 579–583.

A case of malignant myeloma is reported in which the clinical diagnosis was particularly difficult. The course of the disease, nevertheless, followed the usual symptomatology of this type of tumor. The examination of the blood showed nothing significant, except the usual picture accompanying anemia. There was fever and anemia, and severe pain in the bones of the lower limbs which persisted for a long time. The severity of the case was apparent in the unusual rapidity with which the spread of the pulmonary and medullary metastases progressed. This condition is rare, considering the origin of the primary lesions. The writers made use of the roentgenogram in studying this case, and state that this is of especial benefit in the study of myelomas, for it prevents confusion with osteomyelitis and chronic osteitis. The patient in this case died from pulmonary, medullary and mediastinal metastases.

ELOESSER, LEO. Primary tumors of the lung. *Arch. Surg.*, January, 1925, Part II, x, 445–468.

It is pointed out that primary tumors of the lung are apparently on the increase. The increase in recent clinical statistics might be explained by greater diagnostic accuracy but a similar increase noted in necropsies cannot be thus accounted for.

A report is given on 27 cases that have come to the attention of the author; 18 had fairly complete records while the remainder had necropsy protocols but no clinical histories. The series includes only primary tumors of the lung itself and the diagnosis was verified by sections or by necropsy. There were about 12 male cases to each case in a female. The ages were distributed between 36 and 78 years. Sixteen of the tumors affected the left lung and 7 the right. Ten lay at the hilum; 6 affected the upper lobe, 6 the lower lobe and one the whole lung. The frequency of heart metastases is noteworthy; no other tumor shows a similar tendency to metastasize to the heart muscle. The tumor sometimes reaches the heart by direct continuity, travelling through the lymph channels of the hilum into the sheaths of the great vessels and so to the heart. The base of the heart, the coronaries, the pulmonary vessels and even the ascending aorta were found embedded in a massive growth. Other metastases were deposited in the heart muscle as discrete nodules, probably having entered by the blood stream.

The symptoms that should awaken suspicion of tumor are bloody sputum, pain and dense consolidation, although the physical signs in lung cancer are very confusing. Patients with tumors located at or near the hilum suffered from symptoms of tracheal irritation while those with tumors occluding a large bronchus showed symptoms of bronchostenosis closely resembling a closed abscess.

The greatest help in diagnosis was yielded by the roentgen ray. This alone revealed 3 tumors of the series which at some time in their course were operable. However this diagnostic aid proved treacherous and led the diagnosis astray 4 times. In 3 cases it led to the diagnosis of an aortic aneurysm with bronchial stenosis where no aneurysm was found. In one of these roentgenologic diagnoses the tumor stands out on the film so characteristically that it is hard to see how it could have been mistaken for an aneurysm. It is noteworthy that physical and roentgen-ray examination rarely ran parallel.

Eleven of the tumors were of the squamous cell type of epithelioma, 7 were of the medullary type, 2 were adenocarcinomas, 2 were lymphosarcomas and 2 were not examined.

JACOBAEUS, H. C., AND NORD, FOLKE. Air and lipiodol as contrast agents for roentgen diagnosis within the central nervous system. *Acta radiol., Stockholm*, Nov. 10, 1924, iii, 367–382.

A comparison was made of the value of air and lipiodol as contrasting agents in roentgen examinations of the cerebral ventricles and of cystic brain tumors. An analysis of the results obtained in the 3 cases here reported shows that both methods are about equivalent in the case of large cystic cavities. When only a small cavity is present lipiodol is probably more advantageous since it yields better defined shadows.

Ordinarily lipiodol when injected into the ventricles passes rather quickly into the dural sac in the spinal canal without outlining the contours of the ventricles. In such cases the use of air gives much better results. Lipiodol

has the disadvantage that it remains within the cavities for quite a long time; so far as is known at present it causes a slight febrile reaction for the first few days but aside from this effect no other harmful or unusual reactions have been noted to follow its use.

GRASHEY. The importance of roentgen examination in medio-legal work. *München. med. Wchnschr.*, Oct. 3, 1924, lxxi, 1404–1405.

A brief general discussion is given of the advantages and uses of roentgen examination in accident and compensation cases, and of some of the pitfalls to be avoided. The advisability of a prompt roentgen examination in all accident injuries is pointed out. Such a procedure permits the observation not only of the ordinary fractures, etc., but also the detection of fractures superposed on syphilitic bone processes and similar complicating conditions. There is a large field of application in the reexaminations of war wounds. Expert training is necessary in the roentgenologist engaged in this type of work.

LABBÉ, MARCEL, AND LENFANTIN, HENRI. Arterial lesions of diabetes disclosed by the roentgenogram. *Bull. et mém. Soc. méd. d. hôp. de Par.*, April 10, 1924, 3. s., xl, 522–524.

It is known that diabetes may lead to arterial gangrene and lameness. The existence of hypercholesterolemia and arterial lesions is also recognized in certain cases of diabetes. Coincident with the presence of an excess of cholesterine in the blood, there was also noted anabundance of cholesterine in the walls of the blood vessels. To these characteristics of diabetic arteritis, the writers add another, calcified arteries as revealed by the roentgenogram. Two case reports are given. In both it was possible to distinguish the calcified arteries in the affected limbs. The opacity of the arteries, of course, is due to the deposits of calcareous salts in their walls, characteristic of atheroma. The diagnostic value of the roentgenogram is great in these cases, but the prognostic value is less. Atheroma may exist without any physiologic effect on the limbs.

LECONT, MARC, AND OURY, PIERRE. Arteriovenous aneurysm of the left carotid-jugular and the roentgenologic syndrome of right ventricular insufficiency. *Bull. et mém. Soc. méd. d. hôp. de Par.*, June 26, 1924, 3. s., xl, 906–910.

A case report is given of a man who had had a superficial bullet wound in the neck five years previously, who suffered from an aneurysm of the carotid artery near the jugular vein. This diagnosis was confirmed by the roentgenogram. Further roentgenographic study revealed right ventricular insufficiency. The electrocardiograph did not give abnormal tracings from which this diagnosis could be made. Careful observations were necessary in order to do so from the roentgenogram.

LERI, ANDRE, AND COTTENOT, PAUL. Obscure syphilitic osteitis of the cranium disclosed by the roentgenogram. *Bull. et mém. Soc. méd. d. hôp. de Par.*, April 3, 1924, 3. s., xl, 432–436.

Gummatous syphilitic osteitis is easily discernible by means of the roentgenogram, even in cases where it is not so diagnosed by other methods. Paresis and paresthesia have been traced to this cause by this means, and proper treatment given with excellent results. Four case reports are given. In all cases, bismuth treatment was followed by diminution of symptoms and disappearance of the osteitis. An anti-diffusing diaphragm was used in the roentgenographic work in order to distinguish the gummatous lesions. These results are of such importance, in that the use of the roentgenogram gives information not obtainable otherwise, and a very efficient treatment instituted in time to correct the condition noted.

MACMILLAN, HUGH W. Interpretation of dental radiographs. *Radiology*, October, 1924, iii, 340–344.

Due to certain structural features, many parts of the teeth and surrounding bone cannot be shown by the roentgenogram. Pulp vitality or non-vitality is not conclusively disclosed; neither are acute or subacute inflammations of the teeth, gums and peridental membrane demonstrated. The virulence of the infection is not determined roentgenographically. It is emphasized that the size of the destructive area has nothing to do with the virulence of the infection.

The interpretation of the roentgenogram depends upon the general condition of the patient and upon his age. The roentgenogram does not show the character of the root-filling operation. The interpretation depends upon the history of the teeth as in orthodontic treatment, abrasion, accidents or surgical operations. The roentgenogram has not yet been able to demonstrate the character of the pulp and the putrid material under misfitting gold crowns. Here, a negative report is absolutely valueless. The interpretation depends upon the general history, local dental history, laboratory examinations and the evidence peculiar to the patient, none of which is

shown in the film. If dental roentgenograms were interpretated in the same manner that roentgenograms of other parts of the body are interpreted, that is, in conjunction with the clinical findings the patient would be immeasurably benefited.

MENETRIER, P., AND DERVILLE, M. Syringomyelia treated by the roentgen ray. Results observed twenty years after the first treatment. *Bull. et mém. Soc. méd. d. hôp. de Par.*, Apr. 17, 1924, 3. s., xl, 537–540.

Mention is first made of the many observations published in which the good effects of the application of roentgenotherapy in syringomyelia are shown, and particularly the case reported by Lhermitte and Coyon in which necropsy confirmed the beneficial effects of such treatment. The writers give in detail the case history of a patient which they treated for a similar condition (syringomyelia) with the roentgen ray with amelioration of the symptoms to such an extent that the patient was able to continue normally at work for twenty years, or up to the time of the last observation. It seems, then, that roentgenotherapy, when practiced with persistence, will alleviate the symptoms of this condition for an indefinite time, twenty years being certainly a sufficient time to judge of its merits as to permanent benefits derived from the treatment.

NILSONNE, HARALD. Regarding the congenital form of coxa vara. *Acta radiol., Stockholm*, Nov. 10, 1924, iii, 383–406.

A description is given of 7 cases of congenital coxa vara (4 unilateral, 1 bilateral and 2 cases of apparent defect which were found after a few years to have developed into extreme coxa vara). Congenital coxa vara are those cases not due to rachitis or traumatism which manifest themselves in earliest infancy, and which in the roentgenogram present certain characteristic features indicating an early anomaly of ossification in the head and neck of the femur. This anomaly is a disturbance of ossification (possibly due to an embryonic vascular disorder) which gives rise to the coxa vara either during intrauterine life or when weight-bearing is commenced.

Clinically, the congenital form of coxa vara does not differ from other forms except in those cases that present a high grade shortening of the femur. The vertical epiphyseal disc is not pathognomonic of congenital coxa vara, but an irregular epiphyseal disc with rough contours is, on the other hand, of diagnostic value. The picture of an incomplete ossification in the head and neck of the femur, the presence of a zone of rarefaction and the occurrence of several osseous nuclei in the neck of the femur are the distinguishing characteristics most important in the diagnosis.

The therapy does not differ from the one usually employed in coxa vara. In cases in which the coxa vara is not too extreme attempt should be made to effect a cure by means of the abduction method in a plaster of Paris splint. To get any result in extreme cases it is necessary to perform osteotomy.

PRITCHARD, J. S. The value of lateral and oblique roentgen light exposure in the diagnosis of thoracic affections. *Arch. Surg.*, January, 1925, Part II, x, 557–567.

The portion of the thorax behind the heart and basal vessels is not often investigated roentgenographically in the average routine examination of the thorax except when something is discovered suggesting the advisability of oblique visualization.

The following information may be obtained from an oblique roentgen examination of the thorax: the location and size of substernal enlargements, of mediastinal tumors, and of bronchial and thymus glandular tissue; the location of certain foreign bodies; the outline of the exact course of the trachea and detection of any irregularities; the condition of the thoracic spine; the size, shape and density of the thoracic circulatory system; the condition of the diaphragm and the presence of posteriorly formed pleural pericardial or spinal pericardial adhesions; the location and outline of pulmonary suppurations; the behavior of an opaque fluid in its passage through the esophagus; the location of calcareous deposits within the circle of the aortic arch.

A right anterior oblique chest film exposure is obtained as follows: The right side of the chest is placed in apposition to the film. The tube target is set one meter behind the patient and opposite the middle of the left posterior axillary line. The tube is run at 30 ma., 7 to 8 kv., for $\frac{3}{8}$ to $\frac{1}{2}$ sec. The degree of obliquity can be determined with reasonable accuracy after a few trials. The line of penetration of the rays is more of a lateral angle than a true oblique one. A similar exposure of the left side gives a good view of the trachea and its bifurcation. Tumors or enlarged glands in this region are best studied by the left anterior oblique roentgenogram. In all such studies the roentgenoscopic method is of less advantage than the roentgenographic.

The results obtained by this method in 3000 cases are stated to have justified this procedure in a general study of suspected intrathoracic affections.

NOBLE, THOMAS P. Myositis ossificans. A clinical and radiological study. *Surg., Gynec. & Obst.*, December, 1924, xxxix, 795–802.

Myositis ossificans is a comparatively rare disease following both open and closed trauma. It occurs after acute infections and spontaneously when there has been no history of infection or trauma. The commonest sites of myositis ossificans are the quadriceps and the branchialis anticus. When it occurs in the quadriceps it may be confused with sarcoma and a differential diagnosis is important. The treatment in the early stages is rest and fixation. Recurrence is practically certain if operation is carried out in the early stages. Operation is to be considered only after six months and when distinct functional disability exists.

The diagnosis from the third week onward is made clear by the roentgenogram. The shadow is separated from the diaphysis of the bone by a zone of light. This light shadow is very constant except where the callus is concave and encircles the bone. When the disease develops in the brachialis anticus following a posterior dislocation the callus is frequently attached to the coronoid process and appears as a triangular or club-shaped shadow. The latter is by no means a homogeneous one as light areas appear here and there. The light areas in the callus may indicate a cyst or cartilage. The picture changes continually and the shadow gradually darkens and grows more homogeneous. The slow and steady increase in density continues for many months when ultimately the callus becomes attached to the bone where probably in the first instance the periosteum became detached. The zone of light between the diaphysis and the callus does not necessarily mean that the callus is free because there may be a pedicle of spongy bone. A broad zone signifies the absence of such attachment. If a complete muscle is involved the shadow is at first mottled and later becomes homogeneous. Stripes and spots and later lamellae appear which correspond to the ossification of the muscle bundles.

SCOTT, W. J. M. Postoperative massive collapse of the lung. *Arch. Surg.*, January, 1925, Part 1, x, 73–116.

A study has been made of all the reported cases of this condition in order to determine the fundamental characteristics and the limits of variability of the syndrome. Barring the cases of massive atelectasis following war wounds, there have been reported 64 instances in the literature, only 36 of which were reported in sufficient detail. To the latter the author has added 4 cases coming under his observation and the protocols of which are included.

The onset occurred within twenty-four hours of operation in half the cases and after forty-eight hours in only 20 per cent of the cases. Ten per cent of the cases are classified as latent since they complained of practically no symptoms. One or more of the following signs occurred: pain in the chest, cough, expectoration, dyspnea, tachypnea, and cyanosis. The feature that very commonly attracted notice was the sudden sharp rise in temperature, pulse and respiratory rate.

In three-fourths of the cases massive collapse occurred in the right lung, the area involved including the whole lung or only part of it. Usually the extreme apex is relatively clear and the base is involved. The roentgen-ray examination of the chest is of great assistance in establishing the diagnosis when the physical signs are not yet clear. The examination must be carried out under unfavorable conditions because the patient cannot sit up for the roentgenoscopic determination of the cardiac position. In addition, information of great importance as to the mechanism of the collapse is obtained from the evidence of serial roentgenograms beginning early in the development of the condition. The area of dullness shows in the roentgenogram as an area of increased density, sometimes so extreme that even the interspaces cannot be distinguished. The displacement of the heart and mediastinum graphically records the increased negative pressure on the collapsed side. The diaphragm on the affected side, when visible, is high and its respiratory excursion is stopped or greatly limited. The clearing of the area of density occurs at times so rapidly as to make it self-evident that consolidation or fluid could not have been the cause of the shadow.

There are three fairly distinct forms of the condition depending on the symptomatology: (1) fulminating, (2) moderate to severe, and (3) latent. The termination occurs either by lysis, complication or crisis. Such factors as age, sex, season, general preoperative condition and previous lung disease do not seem to have played any significant part in the cases analysed. From the febrile course and the presence of mucopurulent sputum it seems clear that a pulmonary infection usually accompanies the collapse. However, although cyanosis is present, evidence of toxic condition does not exist and the prognosis is good despite the occasional alarming symptoms. On the other hand, a complication by confluent bronchopneumonia may result fatally. Pleural effusion is probably an infrequent occurrence.

Considerable attention is given to theories as to the cause of massive collapse of the lung and the conclusion is reached that the condition

is caused by an obstruction to the respiratory air passages with subsequent absorption of the imprisoned air, thus creating a relative difference in pressure between the two pleural cavities. The obstruction is produced presumably by a reflex stimulation affecting both sides unequally. Unilateral paralysis of half of the diaphragm may be another expression of this reflex. Collapse of lung tissue after operation seems to be a significant element in other lung complications. Infarction in an atelectatic area is suggested as the usual mechanism of postoperative bronchopneumonia.

SICARD AND FORESTIER. Apropos of roentgenography of the urethra with lipiodol. *Bull. et mém. Soc. méd. d. hôp. de Par.*, Mar. 29, 1924, 3. s., xl, 316–317.

Following the use of lipiodol in other cavities for roentgenographic work, this substance is used with entire success for the same purpose in the urethra. Ten c.c. of this oil is injected gently into the urethra and the roentgenogram taken immediately after. The patient is placed in such a position that the whole urethra can be roentgenographed and the canal clearly identified. A case of traumatic contraction of the urethra was studied with very good results. The dilatations are clearly marked; the oil shows anatomic features which are not clear in roentgenograms without the oil. The injection is very simple and harmless and is recommended for general use in diagnosing conditions of the urethra.

VOORHOEVE, N. The roentgenologic image of a hitherto undescribed anomaly of the skeleton. *Acta radiol., Stockholm*, Nov. 10, 1924, iii, 407–427.

A description is given of cases occurring in 3 out of 4 members of a family, the mother being apparently free from this abnormality. It is a systemic affection of the skeleton, very probably hereditary and giving very few or no clinical symptoms. The development of the body is normal, but practically all the bones excepting those of the cranium are affected. Roentgenographically there are two types, namely, those with and those without dark bone striations (as observed in the positive).

The first type is characterized by dark striations or rays following the spongiosa in the same direction as the line of growth of the bone. It is found in the metaphysis of all the long bones and in many other portions of the skeleton. In addition to these rays which often dominate the roentgenogram, a more minute study discloses, (1) clear plaques more or less extensive, or even a rarefaction of the osseous tissue; (2) an enlargement of the metaphysis; and (3) small exostoses and osseous inequalities.

The second type is characterized by the presence of clear spots which are encountered in the epiphyses and certain other parts of the skeleton. The cranium seems to be immune. In the tarsus and at the base of the metatarsus there are two to five pin points of great condensation and these are also found although not so numerous in some of the carpals and phalanges. Here and there, the epiphyseal lines are slightly irregular. There is not a sign of rachitis or periostitis. There are several slight quantitative alterations in the formation of the skeleton (that is, 6 lumbar vertebrae). The condition is most acute in children, especially in those parts of the skeleton showing the most intensive growth; while, on the other hand, it is more moderate in the adult. The boy in whom the acute condition was studied was fourteen years old but showed delayed puberty, with undescended testicles.

It is believed that this disease should be classed in the dyschondroplasia group. Osteopoecilia or osteopathia condensans disseminata and the cases above described are manifestations of one and the same process.

ROENTGEN AND RADIUM THERAPY

FEILCHENFELD, E. J., AND PETERS, A. The successful treatment of myeloid leucemia with thorium x (doramad). *Klin. Wchnschr.*, Aug. 5, 1924, iii, 1449–1450.

The administration of thorium x in proper dosage seems to be far superior in the treatment of myeloid leucemia to all other previous remedies. The dosage must be adjusted carefully to each individual case. The only guide as to dosage is the blood picture produced and these blood examinations should be made at least once to three times a week. Thus, thorium intoxication can be avoided and yet at the same time the leucemic symptoms controlled.

The patient was a woman, aged thirty, whose history indicated a prodromal period of about fifteen years. The treatment with thorium consisted of intravenous injections of 50 electrostatic units of doramad (a trade name for thorium x). After the injection of 150 units in five days, the leucocyte count dropped from 207,000 to 125,000. The treatment continued until the qualitative as well as the quantitative character of the white blood cells approached normal. A relapse occurred and treatment was begun over again without success, but after a total of 1000 electrostatic units had been administered the condition gradually improved qualitatively and

quantitatively. Up to date, a total of 8000 electrostatic units has been administered in nine months.

GROOVER, T. A., CHRISTIE, A. C., AND MERRITT, E. A. The roentgen-ray treatment of hyperthyroidism. *J. Am. M. Ass.*, Nov. 29, 1924, lxxxiii, 1757–1761.

It seems fair to conclude from available statistics that the surgical treatment of hyperthyroidism, both exophthalmic goiter and toxic adenoma, cures about 75 per cent of all cases in which operation is performed; that there is an operative mortality varying from about 1.5 per cent in the best hands and under most favorable conditions, to about 3.5 per cent for the average good surgeon, and that there is a certain unknown percentage of inoperable cases.

A further report is given of 114 cases of hyperthyroidism treated by roentgen radiation. Fifty-eight of the patients are reported as cured and 23 show such definite improvement that they will probably all be placed in the cured list eventually. Six of the total have died but in only 1 patient is death attributable to the results of hyperthyroidism. This was an inoperable case, and the patient died after only one roentgen-ray treatment had been given. These results are regarded as very satisfactory since many of the cases submitted to roentgen-ray treatment are very severe in type with a basal metabolic rate above plus 100 per cent, and since some of them are quite inoperable or operative failures.

There is a large mass of reliable statistics with respect to the ultimate outcome of the surgical treatment of hyperthyroidism but in the case of radiation treatment statistics are as yet incomplete. A comparison of the results, however, indicates that the roentgen-ray treatment will probably furnish about the same percentage of permanent cures as surgical treatment in the best hands. The roentgen-ray method has the advantages that (*a*) there is no mortality resulting from the treatment; (*b*) patients will submit to this method of treatment much earlier than to operation; (*c*) the method is applicable to inoperable and to postoperative cases.

Reports are given upon 5 cases treated with radiation. Patients should first receive roentgen-ray treatment and be operated on only if there is no response to this treatment. This would not apply to patients with toxic adenoma with mild hyperthyroidism who have no vascular or other diseases which render them inoperable. The operative mortality of this class of cases is very low and surgery has the great advantage of removing the tumor. It is believed that roentgen-ray treatment is not so useful in toxic adenoma as in exophthalmic goiter, but that it may be of great advantage in rendering very toxic cases operable and in the treatment of cases that are inoperable for reasons other than hyperthyroidism.

HANDFIELD-JONES, R. M. The treatment of malignant disease of the testicle. *Lancet*, Oct. 25, 1924, ii, 850–852.

The results in a series of cases of simple orchidectomy are presented, and it has been found that it is not practicable to attempt to remove the lymphatic field. A simple orchidectomy will cure a large percentage of cases if these are seen early enough. It should be stressed that any enlargement of the testicle demands an immediate investigation as to its nature. As long as carcinoma and all other forms of malignant disease remain local, a purely local removal is alone required for success; but once the disease has begun to spread surgical procedures, no matter how extensive, show a very low percentage of successful cures.

In those cases with palpable metastases certain auxiliary measures of treatment employing radiation come into consideration. Experience has shown that roentgen radiation and skin applications of radium are of little help. Radium implantation seems to have better prospects. The great tendency of these tumors to metastasize would, however, hardly lead one to expect more than slight palliation from radiation therapy. The results in 23 cases treated surgically by the author show the absence of an operative mortality and a survival for more than four years of 59 per cent.

HEIMANN, FRITZ. Technique and biology of roentgen radiation. *Klin. Wchnschr.*, Aug. 5, 1924, iii, 1436–1438.

The title is misleading. The author discusses the results of radiation therapy of carcinoma of the uterus as compared with the results obtained in the surgical treatment of such cases.

The comparison is, however, not entirely unobjectionable since the results reported upon refer to inoperable cases, mainly in those receiving roentgen treatment. The following treatment was applied to 92 women having carcinoma of the cervix, largely inoperable. The Coolidge tube received 180 to 190 kv., and the radiation was filtered through 0.8 mm. Cu and 1.0 mm. Al, skin-focus distance 30 cm. The radiation was applied front and back through ports 16 × 24 cm., and laterally 9 × 18 cm., care being taken to avoid overlapping of fields. This arrangement required 100 to 120 minutes to produce a skin unit dose. The

percentage depth dose was between 20 to 25 per cent as measured by the iontoquantimeter. The results obtained by this method were no better than those obtained by the old Erlangen technique.

Nineteen cases were selected and a second dose of roentgen rays was applied. In this group 6 patients were distinctly improved by the treatment, 5 were lost from observation, and the remainder were not improved or grew worse. In another series of cases, the technique was changed so that the skin focal distance was increased from 30 to 40 cm., and the time of irradiation increased from 100 or 110 to 160 minutes. This change has only recently been applied and the results in 7 cases show improvement in 6 and no change in 1.

The general conclusion is that radiation treatment at best is but a palliative for carcinoma of the cervix. This applies also to the use of mesothorium. Mention is made of auxiliary measures such as post-radiation treatment with arsenic, collargol, electroferrol, but their efficacy still remains to be determined.

RICHARDSON, J. J. X-ray as an advance in the treatment of impaired hearing. (A preliminary study.) *Illinois M. J.*, May, 1924, xlv, 353–356.

In the course of systematic examinations of patients, it has for years been the custom of the writer to include in all appropriate instances a complete roentgenographic examination of the paranasal sinuses and mastoids. Following such examinations the patients frequently volunteered the information that their impaired hearing had been markedly relieved. It was natural, therefore, to infer that roentgenization of the auditory brain center might be beneficial in deafness.

At first very mild doses were used in such treatment, the radiation being directed to the auditory center on each side. The dose consisted of a low voltage equivalent to about 4-inch spark gap, or 50 kv., and about 8 ma. The results were gratifying at first, the patients finding their hearing acumen positively improved under the new treatment. It was soon found that the radiation could be directed practically anywhere on the head with the same clinical betterment of hearing. The method now consists of gentle irradiation of the head from four angles, focusing for the sake of convenience upon the sella turcica, first through the temporal region of the right, with the central ray one inch in front and one inch above the external auditory meatus; second, over the occipital protuberance with the head inclined forward; third, the left temporal region in the same manner as the right; and finally through the anterior fontanelle, the head inclined backward. It has seemed that the best results are assured with the use of a carefully stabilized current. The roentgen-ray treatment described must, however, be regarded as purely auxiliary. Any discernible and corrigible anatomic or pathologic defect should receive all possible clinical aid.

Experience covering about 600 cases, with approximately 10,000 exposures indicates that the roentgen-ray treatment of deafness is worthy of attention. No harmful effects have appeared from this treatment. The original pathology does not appear to play any obviously determining rôle with respect to the efficiency of the treatment. The improvement may be immediate or become apparent only after several treatments. Relapse may occur but some improvement still remains. The first and most distressing symptom which is usually dispelled is tinnitus, although some patients may complain of increased head noises. Records at present show that not less than 60 per cent of the cases treated have shown improvement varying from slight degree to complete cure.

SEQUEIRA, J. H. Radiotherapeutics in dermatology. *Brit. M. J.*, Sept. 20, 1924, No. 3325, 512–515.

Roentgen-ray therapy has been used for several types of dermatosis. It has been effective in relieving itching and pruriginous skin diseases. Usually a single exposure is effective, and if there is not speedy relief, it is not wise to proceed with this treatment. In psoriasis and chronic seborrhoides where the eruption is limited, an occasional roentgen treatment is of value. However, the tendency to relapse is not removed. In cheilitis exfoliativa several striking successes with roentgen therapy have been observed. Beneficial effects have also been observed in keratoses, cutaneous tuberculosis, granulomata, leprosy, keloids, hypertrophic scars, and rodent ulcer. Squamous cell carcinoma does not respond to roentgen or radium radiation.

The treatment of ring worm of the scalp and beard with roentgen rays has been highly effective. The benefit has not been so great in sycosis. The treatment of hypertrichosis should not be undertaken except in certain grave cases in elderly subjects to whom the possible disfigurement should be carefully explained. In hyperidrosis, the radiations have a distinct influence on the sweat glands without producing a reaction sufficient to cause atrophy, provided the radiation is carefully applied. There is also a beneficial effect of this treatment in acne vulgaris.

Like roentgen therapy, phototherapy produces its local and general effects. Actinic light

has very little penetrative power, the greatest penetration being obtained by concentrated sunlight, or what is more convenient in northern latitudes, concentrated rays from a carbon arc upon a surface rendered anemic by compression. Actinic light differs from roentgen rays in that it has bactericidal power. Good cosmetic result is obtained with Finsen ray therapy in lupus vulgaris. Phototherapy in other skin conditions has not been particularly beneficial. Rickets can be prevented by the light bath and the latter is also of service in convalescence from acute febrile illnesses, especially measles and pertussis.

ANDERSEN, ERNST. The treatment of carcinomas with saline and the intensification of roentgen ray action by salt enrichment of the body. *München. med. Wchnschr.*, Oct. 24, 1924, lxxi, 1493–1494.

Various clinical and experimental observations indicate that increased sodium chloride intake causes an increased cell metabolism in the body. In oats and oatmeal there are insulin-like substances that have the property of increasing the metabolism and at the same time of increasing the salt retention in the body. The metabolism of active cells such as occur in carcinomas is increased with increase in their salt content. This increased activity of malignant tissues should render them still more susceptible to the action of roentgen radiation.

Failure in the treatment of carcinomas may perhaps be ascribable to a state of salt depletion in the patient. The successful treatment of roentgen injury with salt is probably due to the penetration of salt into the injured tissue, which then takes up more moisture and thus dilutes the toxic products and stimulates the metabolism of the injured cells.

The general suggestion for treatment is somewhat as follows: The patient with malignant neoplasm should subsist on an oatmeal diet for several days, supplemented with salt up to the point of producing salt fever; and this is to be followed by irradiation with repeated small doses according to the Opitz end Holzknecht technique. This therapy may be augmented by protein injections. A brief description is given of 4 cases in which this method yielded satisfactory results.

BORAK, J. The most suitable treatment of gynecological hemorrhages. *München. med. Wchnschr.*, Aug. 15, 1924, lxxi, 1119–1121.

All cases of uterine bleeding refractory to medicinal and local treatment can be controlled by roentgen irradiation of the spleen, so that surgical intervention becomes unnecessary. In youthful cases, the avoidance of damage to the ovaries is an important consideration. Irradiation of the liver produces an even more rapid and pronounced effect than that of the spleen.

As a matter of fact, the roentgen irradiation of any of the parenchymatous organs (rich in cell nuclear matter) has the same styptic effect. The resultant uric acid excretion supports the assumption that the action of the radiation is associated with an effect on the nuclear substance.

Three typical cases are cited, the dose of radiation administered being 4 skin units filtered through 4 mm. Al.

CHIRAY, M., AND BENDA, R. On a new case of myelogenic leucemia remarkably ameliorated by thorium x. *Bull. et mém. Soc. méd. d. hôp. de Par.*, March 6, 1924, 3. s., xl, 245–250.

Report of a case is given in which myelogenic leucemia was effectively treated with thorium x after the condition had apparently been checked by radiotherapy. Splenomegaly and greatly increased leucocyte count were marked, as well as decreased numbers of red blood corpuscles. There were 200,000 white corpuscles, 25 per cent myelocytes, and an anemia in which the erythrocyte count was 2,000,000. Roentgenotherapy was instituted, in which irradiations of the spleen were carried out in four treatments. There was no diminution in size of the spleen, and no change in the blood constituents. Treatment with thorium x was then substituted, 400 mgm. being injected at eight-day intervals. Fifteen days after the new treatment was started, a definite and remarkable diminution in size of the spleen, reduction of leucocytes from 200,000 to 20,000, and an increase of erythrocytes from 2,000,000 to 3,400,000 was observed. The patient received 450 mgm. of thorium, and eight days later a still further decrease in size of spleen was noted, with a parallel decrease in numbers of white cells, and increase in red cells. By this time the myelocytes and normoblasts had entirely disappeared. Following this, the patient received 500 mgm. thorium, which was repeated eight days later. Further improvement was noted. The writers are quite sure that the thorium is responsible for the benefits of the above treatment, in spite of the fact that roentgen therapy preceded it. It is thought, however, that a combination of the two treatments will probably give better results than thorium x alone. It is evident, however, that thorium is the more valuable of the two in the case reported.

FAURE-BEAULIEU, M., AND MOUQUIN, M. Acquired hemolytic jaundice accompanied by pulmonary tuberculosis. Myelo-splenic roentgenotherapy. Intermittent presence of isolysins in the course of jaundice and after cure. *Bull. et mém. Soc. méd. d. hôp. de Par.*, June 19, 1924, 3. s., xl, 885–892.

A detailed case report is given of a patient suffering from hemolytic jaundice and pernicious anemia, accompanied with pulmonary tuberculosis, from which complete recovery resulted from roentgenotherapy. The presence in the blood of iso- and heterolysins was a distinct feature of the disease. There was great loss of red blood corpuscles from the blood, and resulting pernicious anemia. Tuberculosis of the right lung was substantiated by the roentgenogram. The usual iron medication did not seem to have any effect. Roentgenotherapy was instituted in the form of irradiations of the spleen and tibia. There was marked improvement shortly after the treatments began, and complete cure of the three conditions was accomplished. The exact reasons for such cure are not discussed, as well as the rôle of the spleen in jaundice. Not only were the distressing symptoms relieved, but the blood picture returned to normal, the tuberculous lesions disappeared, and the sputum became entirely negative. The isolysins also disappeared from the blood. The increase in erythrocytes was marked; from 1,160,000 during the first stage of the disease to 5,560,000 after recovery. The normal proportions of the corpuscles in the blood resulted from the treatment, and a normal condition was completely established. A full discussion of the significance of the various symptoms is given. The importance of roentgenotherapy in this particular case is stressed, and mention is made of a previous successful use of this treatment in pulmonary tuberculosis.

HERLY, LOUIS. Adenomyoma of the recto-vaginal septum; association with pregnancy; radium treatment; apparent recurrence. *Surg., Gynec. & Obst.*, November, 1924, xxxix, 626–635.

All adenomyomata, no matter where situated, show the same clinical reaction, namely, swelling up at the menstrual period. If the entire growth is removed no further trouble may be feared. If portions be left they will continue to grow and lead to pelvic adhesions and further complications. The growth consists of non-striped muscle and fibrous tissue and scattered throughout this are typical uterine glands. The latter may occur singly and in direct contact with the muscle or they may occur in groups. The prognosis in adenomyoma is considered poorer than in myoma. Curetting and medical treatment make it worse.

A case is reported in detail in a woman thirty years old who had undergone a high forceps delivery six years previously. Surgical removal of the bleeding polypoid masses did not relieve the painful symptoms. The patient then received first a surface application of radium followed later by buried emanation tubes. An intercurrent pregnancy was interrupted at the third month to prevent complications. More bare emanation tubes were buried and the growths and symptoms disappeared. Another pregnancy was allowed to proceed to term and successfully delivered by caesarean section. The patient has remained without any further symptoms for three years. The old tumor area is now covered by telangiectasis similar to that following heavy doses of roentgen rays.

This case suggests to the author an etiological factor additional to the inflammatory reaction assumed by many authors. It is suggested that during the first forceps delivery there occurred a mechanical implantation of uterine glands into the vaginal laceration. The latter having been immediately repaired these glandular structures were practically inclusions such as are known to occur in wounds of the skin and which also result in cystic growth. Another case is cited to illustrate the association of adenomyoma with malignancy. Three of four small bright red nodules about 2 or 3 mm. in diameter were removed by a curette from the external os of the cervix in a woman forty-eight years old. One nodule was found to be an ordinary uterine polyp; another showed characteristic structure of adenomyoma; the third, however, revealed a typical medullary carcinoma. The diagnosis of these specimens was confirmed by competent authorities. A radical hysterectomy was performed and revealed the astonishing fact of no further evidence of malignant disease throughout the rest of the organ, the curette apparently having removed the entire malignant process. The patient is in perfect health after three years.

HYMAN, A. The intravesical (cystoscopic) treatment of carcinoma of the bladder by implantation of radium emanation tubes. *Surg., Gynec. & Obst.*, December, 1924, xxxix, 827–831.

In certain selected cases of bladder malignancy the cystoscopic application of radium has a field of usefulness. It may be used as an adjuvant to fulguration; and in the implantation of bare tubes into the base of a cystic papilloma or the surface application

of radium it has proved of considerable value. It is also useful in aged and debilitated subjects, in patients refusing operation or in cases where operation is deemed inadvisable. In small recurrences following operative removal of primary carcinoma and in recurrences following fulguration of papillomas this treatment would be especially indicated. Inaccessible tumors should not be thus treated as it is absolutely necessary to have a clear view of the entire field of operation.

Bare tubes or seeds of radium emanation are used. The average dosage per seed is 0.5 to 1 mc. A seed applicator or introducer is described in detail. One is of the flexible type for use in the ordinary cystoscope, and the other is rigid and adapted for the direct vision cystoscope. The seeds are applied under local anesthesia, care being taken to implant them in the tumor tissue and not into the normal bladder wall. The reaction lasts from 2 to 5 weeks. The tumor then presents a white sloughing appearance which may persist for 2 or 3 months before it is cast off. The latest technique makes use of seeds with a dosage of 0.1 to 0.5 mc. These produce a less marked necrosis but a more even and thorough radiation is obtained. A typical case is described in some detail.

LEE, BURTON J., AND TANNENBAUM, NORMAN E. Inflammatory carcinoma of the breast. *Surg., Gynec. & Obst., Chicago*, November, 1924, xxxix, 580–595.

This is a report of 28 cases from the breast clinic of the Memorial Hospital. The disease has been found to occur in 1.3 per cent of all cases of mammary cancer. It is often fulminating and may result fatally in a short time. The breast on the affected side usually increases in size; the enlargement being diffuse and soft in consistency rather than of stony hardness. The lesion has been found almost always in cases with pendulous breasts, in 50 per cent of whom lactation had never occurred. The rapidity of growth is startling, the tumor often filling the entire breast in a few weeks. The overlying skin is reddened and brawny, and this blush may extend beyond the normal limits of the mammary gland. The skin is hot and slightly tender. Both breasts may be involved almost simultaneously or in rapid succession. As the disease progresses the skin becomes deep red or reddish purple. The inflamed area presents a distinct raised periphery after the fashion of erysipelas. There are no constant changes in the blood picture. There may be a slight leucocytosis and an occasional increase in small mononuclears. There is at no time an extensive breakdown of the skin overlying the breast tissue although minute ulcerations may occur late in the disease. Pulmonary metastases are rapidly progressive once they make their appearance. The patients remain well nourished until late in the course and they die from systemic metastases, the inflammatory symptoms persisting until the end.

It appears that the inflammatory symptoms occur at the very outset of the disease. The age incidence was from 24 to 62 years, the average being 44.6 years; 36 per cent of the cases were under 39 years of age. There is no convincing evidence that the condition is of traumatic origin. Inflammatory carcinoma is rather readily differentiated from abscess of the breast, erysipelas, radiation burns, tuberculosis of the breast, ulcerating carcinoma, cancer *en cuirasse*, Paget's disease of the nipple and gumma of the breast.

A systematic study of the pathology has not been made but study of limited material discloses the dermal lymphatics everywhere invaded by carcinoma cells. This diffuse lymphatic metastasis is the distinctive microscopic pathological feature of this phase of mammary carcinoma. Bacteriological examination of three sections disclosed no single type of pathogenic organism. Biochemical findings showed nothing peculiar about this condition.

The series consisted of 4 cases of primary operable cancer, 14 of primary inoperable cancer, and 10 of recurrent cancer, all of the inflammatory type. Experience has demonstrated the inefficiency of surgery in the treatment of this condition. Apparently the diffuse invasion of the dermal lymphatics militates against a surgical success. This type of carcinoma responds to surgical treatment with an almost immediate and extensive recurrence and a rapidly fatal result. Radiation treatment is indicated even in those cases that are ordinarily classed as "operable." The roentgen treatment consists of five or more exposures over the involved areas using peak voltage of 135 to 140 kv., 4 or 5 ma., focal skin distance 10 to 12 in. with 4 mm. Al. The breast and involved nodes are exposed for 15 minutes. The outlying cutaneous areas are exposed for 5 to 7 minutes, the dosage being planned for each individual. The time between treatments is usually 2 to 4 days. The cycle of treatments is repeated in 6 to 8 weeks or longer if regression has been insufficient or the disease has remained stationary.

Patients with large bulky breasts have been treated more satisfactorily by the use of 200 kv. peak, 4 ma., focal skin distance 20 in. through 0.5 mm. Cu and 1 mm. Al, time 60 to 80 min. The interval between treatments was several days. Lower voltage may be used for the disease

beyond the confines of the breast. Radium as an external agent has not been extensively employed. In one or 2 cases introduction of radium needles filtered with 0.4 mm. Pt combined with roentgen radiation externally gave excellent primary regressions. This form of treatment gives a definite prolongation of life and satisfactory palliation. Well planned radiation may extend life for one to two years. The average duration of disease after admission to the hospital is 8.3 months, and the average total duration of the disease in all 28 cases is two years. Patients who have not had surgical intervention respond best to radiation treatment.

LOUSTE, THIBAUT, AND VALIERE-VIALEIX. On a case of Hodgkin's disease which presented during its course osseous lesions (vertebral and sternal) of difficult interpretation. The amelioration of these lesions by roentgenotherapy. *Bull. et mém. Soc. méd. d. bôp. de. Par.*, May 29, 1924, 3. s., xl, 761–771.

A typical case of Hodgkin's disease came to the attention of the writers in August, 1921. The usual symptoms were noted, with adenopathy of the neck and the axilla and the mediastinum, but no splenomegaly. The Wassermann reaction was negative and the previous history was negative. Histological examination showed the usual cells present in such cases. The case was treated by roentgenotherapy for 8 weeks, one treatment each week. The general symptoms promptly subsided and the glands diminished rapidly in size. Histological sections of these glands confirmed the cure that had been effected. A diminution of the sterno-costal glands, as well as those near the vertebrae, was brought about by irradiation, as well as the neoplastic osseous lesions found in these regions. The latter lesions are of particular interest, because of their rarity in this affection, and because they responded to readily to irradiation. In treating the latter, the following doses were administered:

First series (*2 months*): cervico-dorsal region, 30 H; sterno-clavicular and right cervical, 8 H; sterno-clavicular and left cervical, 8 H.

Second series (*1 month*): cervical and left parotid, 17 H; cervico-dorsal, 15 H; left axilla, 17 H; right axilla, 17 H.

By means of these irradiations, the progressive amelioration of these lesions, as well as other abnormalities of the organism affected, resulted. Three months later, the same treatment was repeated, using a dose of 15 H. Not only were the processes of destruction of the bone arrested, but reproduction of bony tissue was noted. The case is of particular interest because of the ready cure obtained by roentgenotherapy of a rare condition, and one for which there was no precedent as to treatment.

READ, J. MARION. The management of exophthalmic goiter. *J. Am. M. Ass.*, Dec. 20, 1924, lxxxiii, 1963–1968.

It must be recognized that so-called exophthalmic goiter is a disease whose etiology is unknown. This forces the employment of empiric methods. Rationality should guide us so far as our knowledge of the pathologic physiology of the disease will permit. Empiric methods should be properly evaluated and not mistaken for cures or even rational treatment. *It is essential to recognize that exophthalmic goiter runs a fairly definite course and in the majority of cases results in spontaneous cure.*

Although the ultimate cause of exophthalmic goiter is unknown, some of the predisposing and exciting factors seem fairly well established. There is an hereditary factor in some cases. In many instances there seems to be an hereditary instability and endocrine imbalance. Exciting causes may be grouped under three heads: sex epochs, psychic trauma and infection. It is desirable to establish, if possible, which of these causes is operative in any given case since the subsequent therapeutic course and prognosis vary.

Extensive use of the term "hyperthyroidism" implies that the pathologic physiology of the disease is known and has given rise to therapeutic procedures directed toward decreased activity of the gland. The habit of expressing the basal metabolic rate in percentages above and below normal has given rise to the idea that such percentages are a measure of the degree of hyperthyroidism or even the amount of thyroxin secreted. Many observers are coming to believe that there must be marked qualitative changes to account for some of the phenomena that the theory of hyperthyroidism fails to explain.

Mortality Statistics. Lowest possible mortality rate is probably 1 or 2 per cent. This is an ideal not attained by any method of treatment. Surgical results, until recently, show a mortality of 4 per cent.

Morbidity. Duration depends on the severity and varies from six months to three years; average is fifteen to eighteen months.

An analysis is given of the results obtained in 189 cases by various methods of treatment. Forty-eight were treated surgically; 55 had no specific therapy and 86 had roentgen treatment.

Regardless of the method of treatment a marked fall occurs in the mean basal metabolic rate so that a low point is reached in from four to five months. But in each group there is a

secondary rise which, both in height and elapsed time varies directly with the height of the basal metabolic rate at the first crisis. There seems to be a tendency to a second recrudescence at the end of about the sixteenth month. At the end of two years after the first crisis, the average of all patients remaining in the series was approximately plus 10 per cent. The author quotes with approval the following from Barker:

"The average duration of hyperthyroidism associated with diffuse hyperplasia of the whole thyroid gland is probably two or three years, no matter how you treat it (medically, surgically, or radiologically). You may, it is true, compel a subsidence of the symptoms by treatment, but rarely a cure until this time has elapsed; moreover, after recovery from an attack, these patients are prone to recurrence in later life."

In this connection the author makes the following observation: "There seems to exist a general belief that surgical measures, especially subtotal thyroidectomy, will effect a cure if all other means fail, and that patients who are operated on do not have the recurrences to which Barker refers above, and which all clinicians know occur frequently in patients who have once had the disease. In the last three years I have seen twenty-two patients who have submitted to surgery but continue to suffer from the same thyrotoxic symptoms that distressed them prior to operation. The basal metabolic rates of these patients ranged from minus 6 to plus 80 per cent. It must not be supposed that this group had not been skillfully operated on, for many of them had journeyed to the best surgical clinics in the country. Some had had bilateral lobectomy, and one had submitted to six operations on the thyroid. I have dwelt somewhat at length on the surgical aspects of the question because this form of therapy is best known to all, and the belief is prevalent that resort to surgery is always followed by beneficial results, and that the mortality rate is only 4 per cent. It must be remembered that this low death rate is attained in this country at only a few well known thyroid clinics, and it is probable that the operative death rate the whole country over is appreciably more than 4 per cent.

"Nor is it to be assumed that the roentgen ray or any other measure always results in cure. Exophthalmic goiter represents a physiologic or functional disturbance in which both the endocrine and autonomic nervous systems participate. The thyroid function is only one of many that are deranged. All this evidence seems to indicate that this disease is not one of the thyroid *sui generis*, as neither gross nor microscopic changes in that gland are constantly present. For this reason, measures directed toward the thyroid alone can only result beneficially, so far as the thyroid participates in the disease. For this reason neither surgery nor roentgen-ray exposures of the thyroid can be regarded as curative."

Management of the Disease. The aim should be to carry as many as possible through the course of their disease with as little strain on the nervous and cardiovascular system as possible and restore the largest possible number to full social and economic usefulness. Treatment should be begun as soon as possible after inception of the disease. Bed rest is necessary at first in order to estimate the severity of the disease. The amount of rest necessary varies with the severity. In severe cases bed rest is necessary, with more and more activity as improvement occurs.

More important even than rest is avoidance of mental stress. It is necessary to avoid fatigue, both mental and physical. Careful attention to diet is necessary so that increase of weight is assured. Palpitation seems to be a manifestation of derangement of the autonomic nervous system. The heart rate and pulse pressure are increased. The most useful drugs to control the discomfort caused by the rapid and strong heart action are quinin hydrobromid and quinidin. The former has an additional sedative action on the nervous system.

One of the chief aims in management of the disease is to prevent myocardial damage, which leads to decompensation and is the one residuum of the disease from which there is no recovery. It is not, however, a very frequent sequel of the disease and the liability of its occurrence has been exaggerated as arguments for early surgical intervention. Cardiovascular damage is a more constant and prominent feature in toxic adenoma than in exophthalmic goiter. Administration of iodin is the only medication which may be regarded as specific. One of the unfortunate results of accepting an unproved theory of causation of the disease has been the acceptance of Kocher's admonitions against the use of iodin. With the growing tendency to view this disease as representing a qualitative change in thyroid secretion the giving of iodin has become more popular. The author advocates its use not only as used by the surgeon to prepare the patient for operation but also in the treatment of non-surgical cases. The response varies in different individuals and a few do not tolerate it, while others show marked improvement. When compound solution of iodin is used the initial dose should be 3 to 5 drops a day gradually increased to 10 to 12 drops a day.

The author recommends the trial of the roentgen ray in most cases of exophthalmic goiter. "The same skill should be required of a roentgenologist who undertakes to treat these patients as is demanded of a surgeon. In roentgen-ray treatment the mortality rate is nil; at least it is not increased over the irreducible minimum, and no myxedemas, burns or scars are produced with the present technique employed by trained roentgenologists. The period of treatment varies with the severity of the disease and should be persisted in from four to six months, with monthly estimation of the basal metabolic rate. This form of therapy will not prevent recrudescence any more effectively than does surgery, but it has the added advantage that the patient is still under supervision and realizes that treatment must be persisted in until he is sufficiently recovered to require medical attention no longer . . . "

"The half-hearted pursuit of this method has led to its incorrect evaluation by the profession and to unsatisfactory results to the patient."

The following statement is made in the author's summary: "In addition to the time element, which is the most important single factor in effecting a cure, the most effective measures are, in order of their importance, (1) rest, both physical and mental; (2) roentgen ray; (3) iodin; (4) symptomatic therapy, of which quinin hydrobromid is very effective, and (5) in a very few cases, surgical intervention, the type varying with conditions."

SCHMITZ, HENRY. Five year end-results obtained in carcinoma of the female pelvic organs with special reference to radium and x-ray therapy. *Surg., Gynec. & Obst.*, December, 1924, xxxix, 775–780.

Primary carcinomata numbering 584 and recurrent cases numbering 150 were observed by the author from 1914 to 1923, inclusive. All of the 734 cases were subjected to treatment with radium and roentgen radiation. The cases of primary carcinoma were divided according to physical findings into four groups as follows: Group I the clearly localized single growth; Group II suspicion of beginning invasion of tissues surrounding the growth; Group III multiple growths, infiltration of adjacent tissues, fixation of organ or involvement of regional lymph nodes; Group IV extensive ulceration and necrosis, advanced cachexia, extensive involvement, distant metastases. The author has discarded the customary grouping into operable, borderline, inoperable, etc. because such a grouping depends too much on the subjective interpretation of the clinician.

The indications for treatment were: in Group I radical surgical excision; in Group II radium and roentgen irradiation followed by excision; in Group III radium and roentgen irradiation, and in Group IV palliative medicinal treatment. One hundred and eighty primary carcinomas were treated according to the grouping and indications outlined above. After five years the end-results showed 78.5 per cent survivals in Group I; 26 per cent in Group II, and 10.4 per cent in Group III. There were no survivals in Group IV.

The dosage applied in the combined method of radium and roentgen therapy consists of a 100 per cent dose of roentgen rays plus a radium dose of 3600 to 4700 mgm. element hours. Comparison with results from other clinics indicates that surgery is the method of choice in Group I cases. If surgical treatment is used in Group II cases it should be preceded by radium and roentgen irradiation to render the cancer harmless. However, radiation therapy without subsequent surgery gives better permanent results in cervical carcinomata. Radium and roentgen-ray therapy is the method of choice in clearly inoperable cases; 60 out of a total of 1000 clearly inoperable and advanced cases were anatomically healed and subjectively well at the end of five years.

The group of recurrent carcinomata were placed into four similar groups, and the treatment employed radium and roentgen rays with excision where possible. The cases studied usually presented themselves for treatment a long time after operation, probably because the patients thought themselves cured. The total number of recurrent carcinomata from 1914 to 1918 is 63 of whom 5 showed a five-year cure, that is 7.9 per cent. The results in this series of recurrent cases are not decisive.

It is concluded that the radiation treatment of carcinomata of the female pelvic organs compares favorably with surgical treatment if the percentage of cases suitable or not for operation is taken into account.

SIMON, L., AND WOLLNER, W. Shall cases of mammary carcinoma be postoperatively irradiated or not? *München. med. Wchnschr.*, Nov. 21, 1924, lxxi, 1639–1641.

The prognosis in mammary carcinoma is dependent entirely upon an earliest possible operation which must be as extensive as possible. Cases included in Group I of the Steinthal classification show 100 per cent recovery after an early operation. Of all mammary tumors, 82 per cent are carcinoma and about 9 per cent sarcoma. Only the small remainder—9 per cent—are benign tumors. The permanent results in the second and third Steinthal groups

are unsatisfactory and demand the most radical operation with sacrifice of the musculi pectorales and thorough removal of glands. Here postoperative radiation with doses very much lower than the so-called "carcinoma dose" appear to have a favorable action. The irradiation should, however, be continued for a year or a year and a half at intervals of six weeks and longer.

The discussion is based upon a total of 66 cases of which 35 were operated on and 31 also received postoperative irradiation. The latter, in a way, comprise cases slightly less favorable because irradiation was recommended owing to uncertainty as to removal of all the cancerous growth. All the cases were operated on by one surgeon from 1916 to 1921. Taking into consideration the small numbers of the different cases when distributed among the three groups of the Steinthal classification the results are interesting. Of the cases in Group I there was 100 per cent recovery after the 5-year period in all the cases whether receiving radiation or not. In Group II there was a 50 per cent survival after five years in both the irradiated and non-irradiated cases; however, the 3-year period shows only 50 per cent survival for the non-irradiated cases and 69 per cent in those irradiated. In Group III there was no survival in either class for five years but the 3-year period shows 20 per cent survival in those not irradiated and 37.5 per cent in those irradiated.

Reports from various clinics give conflicting data as to the value of postoperative irradiation in mammary carcinoma. The experience of the authors indicates that the dosage used in postoperative irradiation may have been responsible for the different results in the different clinics. They found, for instance, that administration of the so-called "carcinoma dose" was followed by unfavorable response in their patients, and they quickly changed to a system of divided doses very much below the "carcinoma dose." Most of the cases received distant, large field irradiation, skin focal distance of 60 to 80 cm., one skin unit dose being applied through 0.5 mm. Zn. The irradiation is repeated 2 to 4 times at irregular intervals of 2 to 4 months according to the circumstances. The first treatment is given 8 to 10 days after operation and should be administered within three weeks of operation. It is concluded that a prophylactic irradiation in all early cases of mammary carcinoma is not indicated.

FUHS, HERBERT. The roentgen therapy of skin disease. *Wien. klin. Wchnschr.*, Aug. 28, 1924, xxxvii, 841–844.

In the past the great error in roentgen therapy of skin diseases has been the administration of doses containing too large a proportion of soft rays and an altogether too great total dose. Nowadays experience has shown that a dose of uniform rays of medium hardness, that is, 0.16 to 0.15 Å. (about 25 to 27 cm. parallel spark gap) filtered through graded filters of 0.5 to 4 mm. Al, according to the localization is the most successful technique. The dose at a sitting should never approach the erythema reaction. There is temporary contraindication to the irradiation of all those dermatoses which have recently been treated with the stronger irritating physical and chemical agents. Moreover a skin previously injured or affected by radiation should be avoided in future administrations of roentgen rays.

Roentgen epilation of areas of the head for purposes of treating hyphomycoses has been used successfully as a routine, but this has not been applied in the treatment of the various forms of sycoses of the beard. However some success has been obtained in the treatment of hypertrichosis for cosmetic purposes in producing epilation by 3 to 4 doses filtered through 4 mm. Al, administered about three months apart. This demands geat care and skillful technique for successful accomplishment. The method is recommended for removing hair from nevus pilosus.

In combination with other methods of treatment, the use of roentgen rays in various types of skin tuberculosis is advantageous, especially in lupus. The treatment does not prevent recurrence but renders the exposed tissues more amenable to medicinal treatment. Scrofuloderma responds relatively quickly, superficial areas receive 5 to 6 H. through 1 to 2 mm. Al, while the deeper areas receive 7 to 8 H. filtered through 3 to 4 mm. Al. Mention is also made of the fact that illumination with the quartz lamp often gives as favorable results and with less danger.

Actinomycosis of the skin is treated with 9 to 10 H. through 3 to 4 mm. Al in conjunction with surgical or medicinal treatment and is controlled successfully. Rhinoscleroma responds to similar treatment. It is stated that a patient with lepra nodosa receiving 6 H. through 2 mm. Al, repeated several times, was improved and the nodules eliminated. Under certain circumstances inflammatory proliferative or hypersecretory conditions of the superficial glands are favorably affected by roentgen rays. Varieties of acne vulgaris are given 6 to 8 treatments of 2 H., 0.5 to 1 mm. Al, and greatly improved thereby. Recurrent regional furunculosis is frequently cured by a single treatment with 6 to 7 H., 2 mm. Al. Continuous, intensive local hyperidrosis that has failed to

respond to ordinary treatment is frequently permanently reduced by 2 to 4 doses of 8 to 9 H., 4 mm. Al. Stubborn nail affections of various kinds often respond favorably to roentgen treatment of 6 to 9 H., 2 to 4 mm. Al.

Mention is made of the sedative effect of roentgen rays in such conditions as pruritus using 1 to 2 treatments of 1 to 3 H., 0.5 mm. Al. On the other hand, in acute eczemas, roentgen rays seem to be contraindicated as well as inveterate hemorrhagic eczemas of varicose leg and of tyloticrhagadiform areas of the palm and the plantar surface of the foot.

Mention is also made of numerous other conditions of the dermal and subdermal tissues and their responses to radiation.

LANE, LAURA A. Radium in ophthalmology, with special reference to its use in benign affections. *J. Am. M. Ass.*, Dec. 6, 1924, lxxxiii, 1838–1845.

Radium yields good and even specific results in certain eye diseases but there is an enormous field for research, especially with respect to questions of dosage and methods of screening and application. The author has reviewed the whole literature for the past twenty years on the subject of application of radium in ophthalmology, and a summary is given of the effect of radium in benign affections of the eye. A total of 40 different diseases and conditions of the eye and its appendages is listed in which radium has been found of benefit. It is specific in vernal conjunctivitis, trachoma, and angioma. Growths on the lids yielded with excellent results, much better than when removed by surgery, as disfiguring scars and loss of substance are avoided when the radium has been properly used.

Radium gives promise of being a valuable aid in the treatment of ulcers and opacities of the cornea and probably in some affections of the deeper eye structures. At present a better knowledge of dosage, screening and methods of application of radium are necessary in order that maximum results may be obtained. A description is given of the detailed treatment in 10 cases of different eye conditions; and a summary of the results in 30 other cases is presented.

HALBERSTAEDTER, L. Roentgen therapy in internal medicine. *Deutsche med. Wchnschr.*, Aug. 22, 1924, 1, 1138–1141.

A pathologically altered hypertrophic organ with hyperfunction or in a state of malignant degeneration is influenced by roentgen radiation through injury of the pathologic cells or impairment of the cell function. This particular aspect is illustrated by leucemia and its control through irradiation of the spleen and of Basedow's disease influenced by irradiation of the thyroid. Moreover a perfectly normal organ may, by action of radiation in producing cell injury or decrease of function, cause it to influence a pathologic process distinctly external to it. Thus, irradiation of the ovary controls pathologic hemorrhages of the uterus and irradiation of the testicle has an effect upon prostatic hypertrophy.

On the other hand, inflammatory infiltrations, granulomas and tumor cells occurring as a result of certain pathological processes in any organ are influenced directly by roentgen rays through cell injury. This phenomenon may also be interpreted as an increase in resistance of the surrounding normal tissue. The facts in the case are definite but their explanation is a matter of discussion. It is also known that every local irradiation may, under circumstances, cause general effects similar to those following protein injections, that is changes in the blood picture, decrease in coagulation time, etc. An analgesic effect of roentgen rays is undoubtedly present but still remains unexplained. Still another aspect of the application of roentgen rays in internal medicine is the utilization of quantities of radiation which call forth an acceleration of function in an organ instead of injury. This has been widely utilized as for instance in the irradiation of the pancreas for the control of diabetes and the irradiation of the bone marrow in the case of pernicious anemia. This last aspect presents a very much disputed point.

PFAHLER, G. E. Roentgenotherapy in sarcoma of the orbit. *J. Am. M. Ass.*, Jan. 10, 1925, lxxxiv, 87–93.

A report is given on a series of 26 cases observed from 1903 to 1923, all of which are briefly described. They comprised 9 cases of recurrent sarcoma of the orbit, 6 of whom have died. All but one showed definite improvement lasting from two to fifteen months. The poor results in the recurrent cases as compared with the good results in the primary cases would argue against operation and in favor of early and thorough irradiation of the primary tumor. In the primary cases the patients under treatment usually show improvement within a month after the first course of treatment. There is usually reduction in the size of the tumor and in the pain. The earlier the patient is treated, the more prompt and satisfactory have been the results. In nearly all the cases the tumor tissue disappeared completely.

The technique of roentgen therapy in this condition demands the greatest care in outlining the fields and directing the rays during

cross firing so as to preserve the eyelids and the brows. The technique used during the twenty years has passed through evolutionary changes. The roentgenologist must determine or be told of the extent of the disease and he must deliver about 100 per cent of an erythema dose into all the tumor tissue and must not damage normal tissue. In general, during the past ten years the therapy was applied with a 9-in. parallel spark gap, 5 ma., for 20 min. with the rays filtered through a combination filter equivalent to 6 mm. of Al, skin focal distance 30 cm. From 4 to 6 portals of entry were used: (1) a field between the eyebrow and the eyelashes of the upper lid; (2) one above the eyebrow; (3) one below the eyelashes; (4) one or two fields in the temporal and zygomatic region, and (5) an oblique field through the intraocular region of the opposite side. The fields must not overlap and the eyebrows and eyelashes must be carefully protected by lead. Experience has indicated that a biopsy for diagnostic purposes does not seem justified because of danger of spreading the condition.

SCHULTE-TIGGES, H. Reaction to deep roentgen therapy of pulmonary tuberculosis. *Deutsche med. Wchnschr.*, Dec. 12, 1924, I, 1754–1755.

The treatments discussed were administered with a Symmetrie apparatus with a parallel spark gap of 40 to 41 cm., filtered through 0.5 mm. Zn. The size of the field could be varied from 10 × 10 to 20 × 20 cm. and the skin focal distance averaged 30 to 40 cm. The general reactions observed after treatment were lassitude, headache, malaise and pronounced roentgen sickness. Cases of predominantly nodose or fibronodose types of tuberculosis showed in general a greater sensitiveness to radiation than did those of the purely cirrhotic type, although the latter received relatively greater doses. The dosage in the first group consisted of 3 to 6 per cent skin unit dose while in the second case the dose was 10 to 15 per cent of the skin unit dose.

The focal reactions resulting from deep roentgen therapy in pulmonary tuberculosis are of great importance. One effect is an increased scar tissue formation in the productive type of the disease and of increased exudation in the exudative form. As a result of the radiation of tuberculous foci apparently nonspecific protein-like and specific tuberculin-like substances are formed which produce their reactions upon the infected focus as well as upon the body in general. Small doses of radiation avoid the danger of excessive focal irritation. The desired mild stimulation is accompanied by increased sputum, pressure sensation in the lungs and sometimes temporary reappearance of tubercle bacilli in negative sputum. The duration of reaction varies from several days to several weeks. An effect upon the temperature has also been noted.

MISCELLANEOUS

CAMERON, A. T., AND MCMILLAN, J. C. Chloride metabolism in röntgen ray therapy. *Lancet*, Aug. 23, 1924, ii, 365–367.

Metabolism studies have up to the present indicated no change in the pH value of the urine which might indicate an acidosis. Nor was there observed ketonuria or increased lactic acid secretion, so far as preliminary studies go. Five abbreviated case reports are presented which support the following conclusions: Roentgen-ray therapy in massive doses produces a definite lowering of urine excretion and a definite chloride retention when the upper abdomen is irradiated. Irradiation of other parts of the body produces a less effect. Other things being equal, the tendency to roentgen sickness is greater after irradiation of the upper abdomen where the previous chloride excretion is low. Preliminary feeding of sodium chloride daily so that the chloride excretion is raised to 10 gm. or more per day before treatment, with continued administration during treatment prevents or lessens the sickness. The blood chloride is not invariably affected, though sometimes the percentage is lowered. There was usually a slightly greater nitrogen excretion during the irradiation period.

The radiation administered to these 5 cases of carcinoma varied from 10 ma-hr. to 32½ ma-hr. with the other factors adjusted to the conditions of the individual case.

Apparently chloride retention following roentgen treatment is a real thing. The question than arises, what causes this retention and why is chloride therapy of beneficial effect? It is suggested that if roentgen radiation produces a toxin which also reacts with sodium chloride, then if the reaction proceeds sufficiently there should be not only a chloride retention but also a lowering of blood chloride. This interesting possibility should be further investigated.

LEVIN, ISAAC, AND LEVINE, MICHAEL. The action of buried glass capillaries of radium emanation on plant and animal tissues. *J. Am. M. Ass.*, Nov. 22, 1924, lxxxiii, 1645–1650.

An analysis of experimental studies shows that the action of radium emanation upon plant, animal and human tissue is analogous. This action results in complete necrosis of the first zone of tissue, and cellular degeneration in the second zone. Subsequently absorption

of the necrotic tissue and formation of connective tissue take place. Close study of the phenomena involved shows that the mechanism of the action of beta rays differs widely from the caustic effects of heat or chemical agents, and is qualitatively analogous to the action of the gamma rays.

The biologic action of the gamma rays of radium and roentgen rays must depend in the ultimate analysis on the intra-atomic action of these rays upon the atoms exposed. The difference between the biologic action of gamma and beta rays is only quantitative and due to the fact that the ratio of beta to gamma rays in a unit of radium is about 100 to 1. Five mc. of radium emanation distributed in 10 capillaries will destroy 10 cubic millimeters of carcinoma. To produce the same effect by surface application, gamma rays of 500 mc. would have to be employed.

The clinical results obtained in the past five years from the use of radium emanation are very significant. Pathologic conditions that do not yield to large quantities of filtered rays may respond readily to the beta ray action of the buried capillary glass tubes of radium emanation. In epithelioma of the skin the results obtained showed clearly that the beta rays of radium do not act as a simple caustic. The capillaries were placed within the epithelioma but were not allowed to enter subcutaneous tissue. New epidermis appeared in from four to six weeks. In carcinoma of the mouth the most striking observation was the healing and covering with normal mucous membrane of the ulcerations formed by the carcinoma. In some cases the degree of palliation secured was encouraging.

In carcinoma of the lower lip the primary condition can be destroyed by the method of buried capillaries no matter how extensive the process, but recurrence and metastases frequently take place. Surgery is the method of choice in all operable cases. The general results obtained by use of emanation capillaries are much superior to those obtained in previous years by a combination of surface radium application, roentgen-ray therapy, and diathermic coagulation. In carcinoma of the breast without involvement of the axillary lymph nodes, postoperative high-voltage roentgen therapy is applied, together with surface dosage of radium to the axillary and supraclavicular region. In cases with metastases, emanation capillaries are buried in the tumor mass of the breast and in the mass in the axilla. This is followed by high-voltage roentgen therapy and four to six weeks later by a radical mastectomy. In carcinoma of the cervix radium emanation capillaries are employed with or without an accompanying cautery. In the majority of cases no reaction takes place and the patient makes an uneventful recovery. The radium treatment is accompanied in all cases by high voltage roentgen-ray therapy. In carcinoma of the prostate and bladder the insertion of glass capillaries of radium emanation is to date the best single method of therapy for these conditions.

McGrigor, D. B. Radiology (in arduis fidelis). *J. Roy. Army Med. Corps., Lond.*, May, 1924, xlii, 351–358.

Mobility is the first principle of a war organization and any methods of instruction, of technique and of design and construction must fulfil this principle. To accustom the roentgenologist and roentgenographer to work under constant conditions of a civil hospital is fatal to work under the varying conditions of war. The requirements of a military medical roentgenological department are: (1) adequate training; (2) mobility; (3) standardization; (4) safety first; (5) efficiency; and (6) low cost.

Diagrams and suggestions are given for a design of a system of high tension leads suitable for military hospitals anywhere in peace or in war. The main feature of the system is the employment of an overhead gallows system attached to the transformer or coil sets. The wooden posts have upon them short vulcanite stems which support half-inch brass bars to carry the current. The cost of this system is stated to be very small, about one-quarter that of the regular hospital system of "fixed to the roof" overhead rods.

A plain three-ply table top about 6 ft. × 3 ft., on four legs with good casters without any attachments is all that is needed, as with a tube stand a complicated table is unnecessary. In the late war, this lesson was learned and a stretcher on iron trestles frequently fulfilled all requirements.

A portable tube stand is described which fulfils all the military requirements for portability, etc. It consists essentially of a base to be weighted down by generating apparatus or storage batteries and an adjustable arm permitting a wide range of movement for routine work, over- or under-table work, dental roentgenography and general roentgenoscopy.

McGrigor, D. B. Radiology (in arduis fidelis). *J. Roy. Army Med. Corps., Lond.*, August, 1924, xliii, 114–118.

This contribution gives in alphabetical order definitions and explanations of the commoner terms used and conditions found in photo-

graphic technique connected with roentgenography. It is full of the usual details and hints and cannot be adequately abstracted.

SUGIURA, KANEMATSU. The influence of radiations from radium emanation upon tumor susceptibility in albino rats. *J. Cancer Research*, October, 1924, viii, 376–384.

The growth of the Flexner-Jobling rat carcinoma in untreated suckling rats was compared with the growth in similar animals after irradiation with radium emanation. A total of 143 untreated animals and of 337 irradiated animals was studied. It is concluded tentatively that preliminary irradiation of suckling rats with radium emanation is practically without influence upon the susceptibility of these animals to the Flexner-Jobling rat carcinoma. There are, however, indications that the suberythema dose of mild radiations confers a very slight immunity, while larger doses have the opposite effect. Such action, if it exists at all, is so slight that experiments with several thousand animals would be necessary to settle this question.

The radium emanation was contained in capillary glass tubes about 13 mm. in length and 0.5 mm. in external diameter. It was held 2 cm. above the back of the animal and applied for 5 minutes. The amount of radiation applied varied from 0.42 to 23.7 mc-hr., the maximum dosage being fatal.

BACHEM, ALBERT. Unfiltered and filtered x-ray dosage. *Radiology*, October, 1924, iii, 335–340.

Physical and biological investigations by the author as well as others have shown that the intensity of roentgen radiation does not increase in proportion to the spark gap. The intensity, as judged by biological reactions, increases practically in ratio to the square of the spark gap. Hence if the Witherbee and Remer formula for varying kilovoltage is applied, an error is committed. Thus, according to this formula, increase of the spark gap from 3 to 6 inches should double the intensity of the radiation; as a matter of fact the intensity is increased practically 4 times. These considerations apply to unfiltered radiation.

For the calculation of filtered dosage Witherbee and Remer give a formula containing the focus skin distance in the first power, while from geometrical and physical aspects, it should contain the square of this distance. Experiment has demonstrated that the law of inverse squares holds exactly true for filtered radiation; and the omission of the second power of distance in the above formula will lead to serious errors in dosage when focus skin distance is changed.

Another error becomes apparent when we consider the values given for various filter thicknesses. The formula of Witherbee and Remer cannot be used to compare radiations of different filtrations. For unfiltered technique the ratio of a skin unit to an erythema dose is 4:5; for filtered technique the erythema dose is 4 or 5 times larger than the skin unit dose.

The author proposes the following formula for determining the treatment time.

$$t = \frac{(\text{focal skin distance})^2 \times k}{(\text{spark gap})^2 \times ma}$$

The distances measured are in inches. The physical biological factor k depends on the biological fact desired, that is, for the three conditions, namely: skin unit, a mild, or a pronounced erythema. It further depends on the filter used, increasing with increase in filter thickness.

A table is presented giving the various values for differences in the factors of the above formula. As indicated by the value of the factor k, the skin unit dose is about 30 per cent weaker than a mild erythema dose. For unfiltered and slightly filtered rays there may be even less difference between doses. For unfiltered rays a mild erythema is required sometimes if epilation is desired.

The formula above considers mostly the physical principles underlying dosage, but it does not and cannot consider all factors determining dosage—for instance it does not consider the size of the field. It also does not take care of the variation existing between various transformers and tubes, therefore variations of the treatment time of 20 to 30 per cent are common. If it is desired to avoid all these inaccuracies, it is necessary to abandon the indirect method of determining dosage and make measurements with the exact conditions of treatment. The most convenient instrument to determine surface intensities is the Fürstenau intensimeter, but such instruments before being used should be compared with others or should be standardized, then each treatment can be controlled and inaccuracies or serious errors easily avoided.

ROUSSY, GUSTAVE. Experimental studies on cancer. *Presse méd., Par.*, Mar. 8, 1924, No. 20, 209–213.

The author has attempted here to discuss fully the nature of cancer, the various means of producing different types of cancer, and the theories underlying this peculiar phenomenon. Cancer is very common in practically all kinds of animals, even wild animals, such as the lion, tiger, etc., as well as in birds, molluscs and insects. This affection is the same in animals

and man. In rodents, it is possible to transmit cancer by grafting in series in the same species. Finally, cancer may be produced by artificial means, causing conditions quite like those occurring naturally. Agents which may be used for producing artifical cancer are: application of the roentgen ray, tar, coal products, ingestion of parasites, etc. Cancer due to roentgen rays is well known because of the numerous victims of the effect of this agent on the skin. Malignant tumors have been produced in the rat by the application of this agent, such tumors occurring in about 12 to 14 months; they recur after removal of the growth. Tumors so produced may be transferred in series by grafting under the skin of rats. These cancers are polymorphous sarcomas. Bloch in 1923 was able to produce an epithelial cancer in the ear of the rabbit by means of application of the roentgen ray for 3 years. Barlow caused cancer in the mouse by the subcutaneous injection of sulfate of radium and in the rat by the introduction of small tubes of radium. On the other hand, Contamin and Clunet have shown that when fragments of tumors have previously been treated with roentgen ray *in vitro* and then grafted into the skin of rats, they do not produce tumors. Animals inoculated with tumor material previously exposed to roentgen rays remain resistant for a long time to new grafts of fragments of new tumors. Analogous experiments have been carried on by Chambers, Scott and Russ at Middlesex Hospital, London. The latter workers removed a tumor, without extirpation of the ganglia, and made an emulsion of it; this was then exposed to roentgen rays or the rays of radium. Subcutaneous injection of this treated emulsion into cancerous patients in a number of cases had a beneficial effect. The writer has not been able to repeat these results in his own work; however, he is interested in this form of therapy and suggests further work in this field, using both roentgen rays and radium in the treatment of cancer. It is extraordinary that radioactive substances should have these two opposite effects, stimulating and destructive. Proper application of radioactive substances may be very effective in destroying tumor growth, but their other property must also be considered.

STENSTROM, WILHELM. Some practical points concerning installation and dosage measurements of a water-cooled roentgen-ray tube for deep therapy. *Acta radiol., Stockholm*, Nov. 10, 1924, iii, 428–441.

A description is given of the installation and general operation of a water-cooled high voltage roentgen-ray tube used for deep therapy work in the Institute for Study of Malignant Disease, Buffalo, N. Y. The operating conditions are, 200 kv. peak, 30 ma., 0.48 mm. Cu, the current being delivered by a 280 kv. Victor machine, with four-arm rectification. This tube has been run for a total of 200 hours without any change, and has proven easy to handle.

Ionization measurements show the effective wave length at 200 kv. is 0.161 Å. at 8 ma., and 0.167 Å. at 30 ma. It was found that the change in depth dose was very small and that the distribution of radiation at a focus-skin distance of 40 cm. or more is practically the same for the water-cooled tube as for the Universal tube, and that 100 ma-min. obtained with 30 ma. produces approximately the same roentgen-ray radiation as 75 ma-min. obtained with 8 ma. The time for the same dose at different distances from focus to skin can be approximately calculated by the square distance law but a small correction is necessary when greater accuracy is required.

It is not yet settled whether the clinical results will be better or worse after the short intense treatments given with this tube than after those requiring longer time. However, roentgen-ray sickness immediately after treatment is reduced, and skin erythema is produced by slightly smaller doses as measured by ionization chamber when 30 ma. is used than when 8 ma. is used.

ABELS, HANS. On retarded development of a new-born child caused by roentgen radiation in early fetal period. *Wein. klin. Wchnschr.*, Sept. 4, 1924, xxxvii, 869–870.

The mother, thirty-four years old, a quadripara, had received one abdominal and two sacral exposures from a Coolidge tube at 30 cm. focal distance, 8 skin units, filtered through 0.5 mm. Cu, for 30 to 45 min. on three successive days. The radiation was applied to control hemorrhages due to uterine myomas. These treatments were administered two months, or perhaps a little later, after conception. She gave birth to a boy weighing only 1950 gm. and 41.5 cm. in length. This child gave none of the usual signs of being premature. It was fairly well formed except for the shape of the head which very much resembled that of microcephalus. The most striking feature was the appearance of the eyes; the lid slits were very much underdeveloped, far in excess of the usual mongoloid deformity. After three weeks a slight separation of the lids could be obtained and it was then discovered that there existed a microcornea with a maximum diameter of 4 to 5 mm., and a deep seated bilateral microphthalmos.

Functionally, the child appeared normal except for an increased tenseness in the muscu-

lature of the lower extremities. Roentgen examination disclosed extensive deposits on the cortical parts of the long bones giving strong suggestion of syphilitic periosteal changes. There was, however, no evidence that such a condition was present, and the Wassermann and Meinicke reactions in mother and child were negative. The further development of the child in length and weight has been quite decided and at six weeks there has appeared a spontaneous opening of the eyelids, although only to the extent of a few millimeters.

It is believed that the retardation of development above recorded is directly ascribable to the effects of roentgen radiation during the fetal period and this case is unique since general experience has shown that roentgen action usually results either in an abortion or in no demonstrable effect upon the offspring.

Ivy, A. C. McCarthy, J. E., and Orndoff, B. H. Studies on the effect of roentgen rays on glandular activity. *J. Am. M. Ass.*, Dec. 20, 1924, lxxxii, 1977–1984.

A report is given on experiments made on the dog to demonstrate the effect of the exposure of abdominal and thoracic areas to roentgen rays on gastric secretion together with observations on roentgen cachexia. Pawlow pouch dogs were used and the method of experimentation was the same as that previously carried out by Ivy and his coworkers.

Two dogs received over the right lower abdomen a dose of short wave length roentgen rays sufficient to produce a first degree burn. There was immediate vomiting and partial anorexia which was followed by complete anorexia and anacidity beginning from 2 to 3 days after the exposure and persisting for about 5 days. There then followed a return of appetite and gastric secretion to normal for a period. Four or five days prior to death, which occurred at 3 and 7 weeks respectively, there was recurrence of complete anorexia and achylia. Intestinal ulcers were found in both animals. These results were distinctly different from the results obtained when a similar exposure was made over the thoracic area. In the latter case, although a burn resulted there were no symptoms whatever of altered gastric secretion or cachexia.

A group of 7 dogs received a human erythema dose of short roentgen rays over the abdomen. The sequence of events was, (1) immediate vomiting in 4 of the 7 animals; (2) partial anorexia and hypernormal secretion of gastric juice during the first two days after exposure in 5 of the 7 animals; (3) partial or complete anorexia, hyposecretion and anacidity, beginning on the third day and lasting two or three days in all animals; (4) recovery or death depending apparently on the vitality of the animal. In the 3 recovered animals chronic intestinal ulcers were not found at necropsy. Two dogs received the usual "unit dose" (75 per cent of the human erythema dose) employed in the treatment of malignant tumors. These animals reacted quite similarly with respect to immediate symptoms and effects on gastric secretion, but a hypernormal gastric secretion did not occur and the symptoms of acute intoxication were mild. There was, however, very definite depression of gastric secretion.

These observations confirm the older ones on the sensitiveness of the intestinal mucosa to roentgen rays, the intestinal mucosa being at least twice as sensitive as the fundal mucosa of the stomach. These findings do not warrant the use of roentgen rays for treatment of conditions in which it is desirable to reduce gastric acidity.

Attempts to cure "roentgen cachexia" in dogs by means of sodium chloride injections were unsuccessful. It seems from the observation on these dogs that the cachexia is not due to anorexia because the animal eats sufficiently and sometimes voraciously. It is probably not due to a disturbance of the blood picture or to disturbed gastric digestion. It appears that cachexia following exposure on the abdomen may be due to a chronic intoxication and also to disturbed intestinal digestion.

Jaller, Cäcilie. Sedimentability of red blood cells after roentgen irradiation of the blood *in vitro*. *Deutsche med. Wchnschr.*, Aug. 8, 1924, l, 1080–1081.

In a total of 12 experiments the rate of settling of the red blood cells after irradiation *in vitro* was found to be essentially the same as that of the non-irradiated specimens. No retardation of settling could be demonstrated.

These observations of the effect of roentgen radiation *in vitro* are quite different from those reported by Mikulicz-Radecki on the sedimentation of blood cells after irradiation *in vivo*. In the latter case distinct retardation of sedimentation was reported.

McGrigor, D. B. Radiology (in arduis fidelis). *J. Roy. Army Med. Corps, Lond.*, November, 1924, xlii, 366–371.

The present contribution of the author's series of papers on roentgenological laboratory technique deals with the dark room, its general arrangement and protection and the numerous details of the development and finishing of roentgen films and plates. A good deal of ordinary photographic technique is included.

NIMS, CHARLES H. Deep therapy simplified. *Radiology*, November, 1924, iii, 394–395.

A chart is presented for the purpose of simplifying procedure in treatment. Two essential factors are made variables, namely, the filter thickness and the voltage. The current is maintained at 5 ma., the distance is 22 in. and the field covered 6 in. square. The chart presented shows a curve which indicates the combination of filter and voltage which will yield a safe standard suberythema dose in an exposure of one hour. Erskine's table of depth doses forms the basis of this chart.

The author minimizes the importance of careful formulation of all factors governing dosage as introduced by physicists, but he is careful to point out that the use of an ionto-quantimeter to check the dosage indicated on the chart should not be neglected.

ROTHER, JULIUS, Influence of roentgen rays on the vegetative system. *Deutsche med. Wchnschr.*, Aug. 22, 1924, I, 1141–1143.

The upper abdominal region of a rabbit was irridiated with one-half skin unit of hard rays and there resulted an enormous drop in the minimum blood pressure. This drop in blood pressure is not nearly so great when the skin is removed and the radiation applied to the underlying tissues in otherwise exactly the same manner. Such experiments seem to indicate that the skin as an organ is an important element in transforming the radiant energy into an effect upon the blood pressure.

Experiments were also conducted upon the effect of the radiation upon the blood sugar curve in rabbits and dogs. Here also a stimulative factor was demonstrated. The point of origin of this stimulus lies in general in the upper abdominal region and may also lie in the liver or in the pancreas. Irradiation of these always results in a blood sugar increase. When, however, both adrenals are extirpated no such change in the blood sugar is produced by the roentgen rays. Evidently, the adrenals of the network surrounding them are indispensable in the production of radiation-hyperglycemia. Experiments are cited to show that the adrenals are in themselves sensitive to radiation.

It is believed that similar phenomena undoubtedly occur in man but observations on this point lead to the conclusion that the blood pressure and blood sugar changes are ordinarily rather slight. These experiments nevertheless point to what is termed a "stimulative" action of the roentgen rays upon certain reflex nervous mechanisms in the body.

WEINREB, OSCAR. Vacuum measurements on *x*-ray tubes. *Radiology*. November, 1924, iii, 396–398.

An investigation of the effect of gas at low pressures in roentgen tubes showed that at extremely low pressures of the order of 10^{-6} to 10^{-5} mm. there was no considerable decrease in relative intensity of roentgen rays of different wave lengths. The decrease, however, grows very rapidly as the pressure is raised to 0.005 m. The decrease of intensity in the short wave lengths was relatively larger than in the long ones. The influence of gases on roentgen-ray energy output can be detected at lower pressures with low filament temperatures than with high temperatures. In these experiments use was made of a modified Tschudy hot filament vacuum meter, which was found to be a sensitive instrument for measuring low pressures.